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THE WORLDWIDE TECHNICAL AUTHORITY • OF AMATEUR • SHORT WAVE AND EXPERIMENTAL RADIO •

This Month

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RADIO

he publishers assume no responsibility for statements made herein by contributors and correspondents, nor does publication indicate approval thereof.

In this issue "Radio" presents:

"RADIO" CONTRIBUTIONS

Contributions to our editorial pages are always welcome; though they will be handled with due care we assume no responsibility for those which are unsolicited; none will be returned unless accompanied by a stamped, addressed envelope. We do not suggest subjects on which to write; cover those you know best; upon request, we will comment on detailed outlines of proposed articles, but without committing ourselves to accept the finished manuscript.

Since we regard current "chiseling" policies as decidedly unfair, a small payment will be made, usually upon publication, for accepted material of a technical or constructional nature. Freehand, pencilled sketches will suffice. Good photographs add greatly to any article; they can easily be taken by the layman under proper instructions. For further details regarding the taking of photographs and the submission of contributions see "Radio" for January, 1936, or send stamp for a reprint.

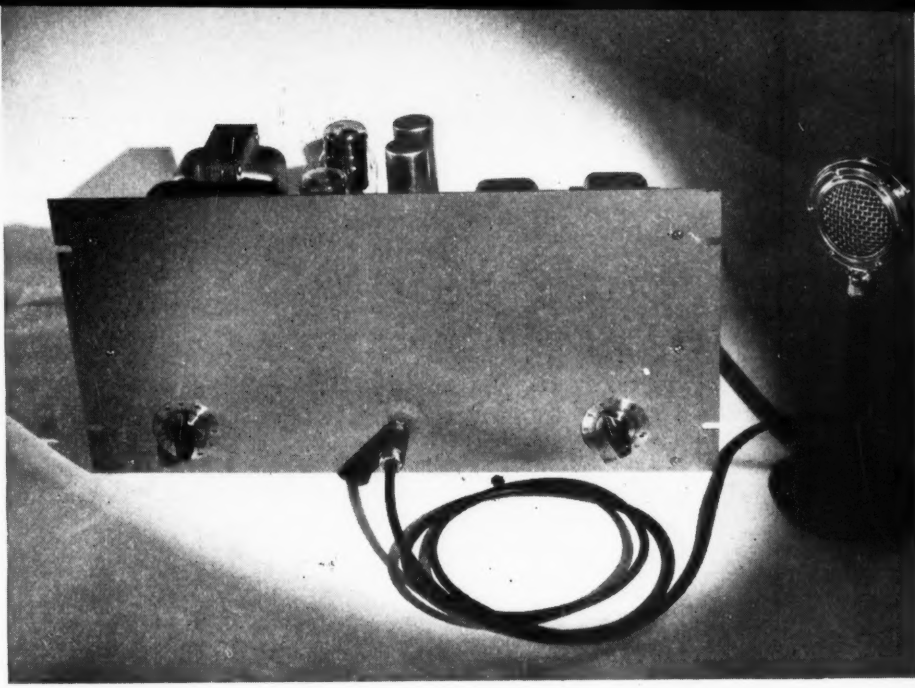
THE WORLDWIDE TECHNICAL AUTHORITY OF AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO

John L. Reinartz, W1QP

THE HISTORY OF AMATEUR RADIO encompasses a brief-enough span that a number of men associated with it in the early days are still at the fore in modern development.

■ Perhaps one of the best known of these is John L. Reinartz, W1QP. Starting back in 1908 with the then up-to-date coherer—tuners wound on everything from Quaker Oats boxes to rolling pins—, he has been identified with numerous circuit improvements, both receiving and transmitting, as well as with such milestones in amateur radio as the Reflection Theory in 1925, the first amateur communication with Europe (with Fred Schnell of the United States and Deloy of France) and, with W6TS, the first daylight transcontinental amateur contact. Mr. Reinartz was also prominently identified with the success of the Byrd-MacMillan North Greenland Expedition when day and night communication was first maintained with amateur stations.

■ Lately, he probably has been best known to amateurs because of his "Reinartz Rotary Beam Antenna". His work and his two chief hobbies, amateur operating and NCR activity, all are very closely connected; he is one of RCA's consultants on tube applications for radio amateurs.



• Rack - mounting speech amplifier incorporating the circuit discussed herein.

PEAK COMPRESSION...
Applied to the Speech Amplifier

By **RAY L. DAWLEY,* W6DHG**

Although automatic peak limiting systems have been in use for some time on long communication lines, it is only recently that they have come into the foreground for use on radiotelephone transmitters. Some months ago W. E. introduced its 110A program amplifier to the broadcast field. The acceptance of the device was insured by the fact that it actually did give the "3 db" increase in effective radiated power that was advertised for it.

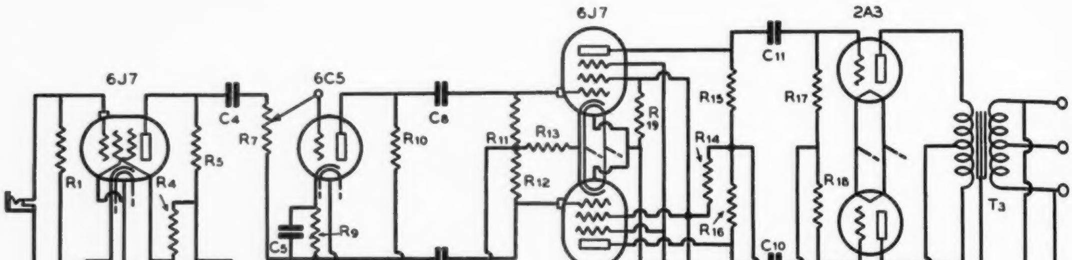
To analyze the arrangement, we see that it consists first of two medium-gain speech amplifiers with a variable attenuation pad inserted between them. This pad consists of a network of "varistors" (whose resistance is dependent upon the polarizing voltage being impressed upon them) connected so that variations in a control voltage will change the attenuation of the pad. This control voltage is obtained from a peak rectifier which is fed from a separate audio amplifier. The excitation for this control amplifier is taken from the *output* of the entire audio channel.

This peak rectifier is biased so that it will not come into play until the transmitter being fed by the amplifier is being modulated approximately 80%. As the audio signal increases above this level, the rectifier begins to apply voltage to the "varistor" pad, thus lowering the gain of the amplifier. An RC network in the return of the rectifier is adjusted so that the time constant of the system is quite low, approximately that of the syllabic variations in ordinary speech.

To increase the modulation percentage from 80% to 100% requires an increase of 2 db in the audio voltage appearing at the transmitter input. With this special amplifier in the circuit, it requires an increase in *input level* of *5 db* to produce this 2 db rise in output from 80% to 100% modulation.

The system has many advantages. The gain on a "peak compressing" speech amplifier may be operated at a higher point without danger of overmodulation. This means that the *effective* audio power in the sidebands of the transmitter may be considerably increased.

*Technical Editor, RADIO.



SCHEMATIC DIAGRAM OF THE SPEECH AMPLIFIER

C_1—10 µfd., 25 volt elect.
C_2—0.5 µfd. 400 volt tubular
C_3—8 µfd. 450 volt elect.
C_4—0.1 µfd. 400 volt tubular
C_5—10 µfd. 25 volt elect.
C_6—8 µfd. 450 volt elect.
C_7,C_8—0.1 µfd. 400 volt tubular
C_9—0.5 µfd. 400 volt tubular
C_{10},C_{11}—0.1 µfd. 400 volt tubular
C_{12},C_{13}—8 µfd. 450 volt elect.
C_{14}—0.1 µfd. 400 volt tubular
C_{15}—1.0 µfd. 400 volt tubular
R_1—5 megohms, ½ watt
R_2—5,000 ohms, 1 watt
R_3—50,000 ohms, 1 watt
R_4—250,000 ohms, 1 watt
R_5—250,000 ohms, 1 watt
R_6—10,000 ohms, 1 watt
R_7—500,000 ohm potentiometer
R_8—50,000 ohms, 1 watt
R_9—5,000 ohms, 1 watt
R_{10}—50,000 ohms, 1 watt
R_{11},R_{12} — 250,000 ohms, 1 watt
R_{13}—2,000 ohms, 1 watt
R_{14}—250,000 ohms, 1 watt
R_{15},R_{16} — 250,000 ohms, 1 watt
R_{17},R_{18} — 250,000 ohms, 1 watt
R_{19}—50,000 ohms, 1 watt
R_{20}—750 ohms, 10 watts
R_{21}—70,000 ohms, 1 watt
R_{22}—250,000 ohms, 1 watt
R_{23}—50,000 ohms, 1 watt
R_{24}—15,000 ohm potentiometer
T_1—Power transformer; 750 c.t., 5 volts 3 amps, 6.3 volts 3 amps., 2.5 volts 2 amps.
T_2—1½/1 ratio interstage transformer
T_3— Multiple-match driver transformer
CH_1—200 ma. swing choke
CH_2—20 hy., 100-200 ma. filter choke
SW—Optional a.c. line switch

Since we are not primarily interested in fidelity in amateur transmission, we may set our "peak-compressing" speech amplifier so that it begins to operate at a slightly lower level than is permissable in broadcast work. Of course, if we operate the amplifier so that it begins to compress at too low a level, we have made it into nothing more than a volume compressor, and its peak attenuating capabilities are thus nullified. Experience has shown that the compressing action should start to take place at from 70 to 80% modulation if the best peak limiting capabilities are to be obtained.

Also, from another point of view, the compression should not begin to take place at too low a value of modulation percentage, since, even with the best systems of compression, there is a certain amount of distortion introduced. This distortion is of two types: syllabic distortion and harmonic distortion. The amounts of these two can and have been minimized in the amplifier to be described. But the best way to stay clear of trouble from these sources is not to use too much compression; the point of initial operation should be adjusted with careful attention to the quality as heard in the monitor and to the modulation percentage as measured with a suitable indicator.

Electrical Design

The speech amplifier to be described is one that is designed to feed the grids of a pair of zero-bias fifty watters of the 203Z or 838 type used as a class B modulator. The input and output stages of the amplifier are conventional; the first designed to give sufficient gain to operate a crystal mike and the last designed to

give ample output power for the grids of the modulator stage. The balance of the amplifier is the unconventional part and comprises the phase inverter, the push-pull variable gain stage, and the audio peak rectifier.

It is this part of the amplifier, the 6C5, the push-pull 6J7's, the 6H6, and their associated equipment that comprises the gain limiter and peak suppressor. This is the part that may be inserted into an old speech amplifier, or designed into a new one, to provide these features.

The entire amplifier will be described to eliminate any doubts as to the proper design of a similar unit.

The first stage, a 6J7, operates as a conventionally connected pentode voltage amplifier. Since this tube was designed to operate primarily from a standard crystal microphone, no gain control was incorporated in its grid circuit. Instead, the gain control for the amplifier was placed in the output of this tube or rather in the grid circuit of the next tube, the 6C5.

The Phase Inverter

In this type of a volume-compressing circuit, the compression tubes must operate in push-pull. The reason for this is obvious; since there is a control voltage being impressed upon these tubes, and since it is varying at a syllabic rate, if we impress the voltage upon the grid of only one tube there will be a component in the plate circuit that is proportional to the *control* voltage variations. This will be amplified by succeeding stages and finally transmitted by the rig as a "hush-hush" noise every time an audio signal is impressed on the amplifier. This trouble has been encountered in some of the single-ended compression systems that have been described heretofore. It has been found that the most effective way to cure the condition is to use a push-pull arrangement in the amplifier and to feed the control voltage *in parallel* to the two push-pull tubes. Thus the control voltage variations will cancel out in the combined output of the plate circuits of the two tubes.

A push-pull input transformer may be used to obtain the 180° out-of-phase voltage for the two tubes, but since the transformer must operate at a comparatively low level, there would be danger of hum pick-up. A phase inverter is a better solution to the problem. A 6C5 tube is used as the inverter in this amplifier.

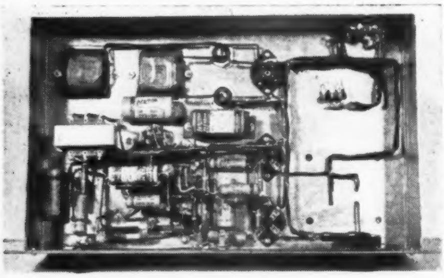
The particular phase inversion circuit used has a gain of one. In other words, there is no additional gain introduced by this stage. Ample gain is supplied by the combination of the single-ended 6J7 first stage and the push-pull 6J7 "variable gain" stage.

The Variable-Gain Stage

Two push-pull 6J7's, pentode connected, are used in the variable-gain stage. The output of the phase inverter, the 6C5, is resistance coupled to the input, and the plates are resistance coupled into the succeeding amplifier. The stage itself is conventionally connected with the exception of the suppressor circuit. It is into the suppressor circuit that the control voltage is coupled.

With the amplifier operating below the point at which compression takes place, the suppressors are at ground potential, but slightly negative with respect to the cathode. When a signal of sufficient amplitude to cause current to flow in the peak rectifier is encountered, a negative potential, proportional to the amplitude of this signal, is impressed on the suppressor grids of these two 6J7 tubes. This biasing potential on the suppressors reduces the transconductance of

• View from above showing the completed amplifier.



• Bottom view of chassis showing wiring and parts placement.

the stage. Since the gain-per-stage is directly proportional to the μ, the plate load resistance, and the transconductance, and since the first two of these remain substantially constant as the suppressor voltage is varied, the gain will vary as does the transconductance.

This variation in gain with suppressor bias is very smooth and quite satisfactory up to a certain point (which is encountered in all variable-gain v.t. amplifiers), the point where plate current cut-off is approached. At this point, operation becomes erratic and distortion is introduced. However, by placing the source of biasing voltage *after* the stage in which the gain is controlled, any difficulties that might be introduced from the above condition are eliminated. As the gain of the controlled stage is reduced, the output voltage of the complete amplifier is reduced a proportionate amount. Consequently the point at which the non-linearity in the control stage begins to appear is continually being "held back."

The Control Rectifier

A 6H6 tube is used as the peak rectifier to supply the control bias to the 6J7's. It is connected as a full wave rectifier and is fed from a center-tapped audio transformer. The primary of this transformer takes its audio voltage directly from the leads that go to the class B modulator grids. The ratio of the transformer is 1½ to 1, step down. It was somewhat of a problem to find a transformer of this turns ratio with a center-tapped secondary. There were plenty of them with center-tapped primaries and this ratio but none with c.t. secondary. However, the problem was finally solved by using a push-pull interstage transformer, turned around backwards, with the tap on the "new" primary left floating.

If the control rectifier, the 6H6, were to begin to operate as soon as a signal came through the amplifier, continuous compression would be had and the peaks would go through, altered only to the extent that the balance of the signal is altered. This, of course, is not what we desire. However, if a biasing voltage is placed upon the control tube, the point at which the rectifier begins to draw current and place bias upon the 6J7's can be manually adjusted. Potentiometer R_{24} in the diagram serves this function.

By means of this potentiometer a positive bias is placed upon the cathodes of the 6H6 control rectifier. Thus no rectification will take place until the instantaneous plate voltage exceeds the bias placed upon the rectifier cathodes.

By adjusting this bias to the point where current will not flow until the transmitter being fed by the amplifier is being modulated 70 to 80%, signals of greater amplitude will cause current to flow with a consequent reduction in the gain of the amplifier.

This adjustment can best be made by means of an oscilloscope, or other modulation checking device, and a high resistance voltmeter placed across the resistor R_{22} in the suppressor circuit of the 6J7's. A constant tone is fed to the input of the amplifier and its intensity adjusted until the transmitter is being modulated about 75%. Then, by watching the voltmeter in the suppressor circuit, the potentiometer R_{24} is backed off until the point is reached where no voltage is appearing on the suppressors. Now, if the input to the speech is increased past this point, current should flow in the rectifier circuit, bias will be placed upon the suppressors, and the gain of the amplifier will be proportionately reduced.

Our peak suppression now comes into play; due to the compressing action of the amplifier, peaks which ordinarily would considerably overmodulate the transmitter will be compressed by the action of the speech amplifier. Also, due to this peak compressing action, all normal speech of amplitude great enough to modulate the transmitter more than 75% will be compressed in proportion to its amplitude. Thus the gain control on the speech amplifier may be operated at a higher position (with a consequent increase in average sideband power) with this type of a speech amplifier than with one of the conventional type.

The RC circuit in the suppressor return of the 6J7's determines the time constant of the compression circuit. In this case, with these particular values of resistance and capacity, the time constant is in the order of the period of

the syllabic variations in ordinary speech. If slower action is desired, the capacity of the condenser may be increased; if more rapid, the capacity may be decreased.

The Push-Pull Power Amplifier

The power amplifier stage, using a pair of 2A3's, is entirely conventional except that resistance coupling is used into the grid circuit. The plate circuits of the two tubes work into one of the new multiple-tap driver transformers. The taps on the secondary of the transformer may be varied to suit the particular tubes that are to be used in the succeeding stage.

The power supply also is conventional. A single 83 tube is used as rectifier and the various stages are filtered in accordance with the level at which they operate.

The amplifier has an undistorted output of about 8 watts at the plate voltage employed, more than ample to drive the previously mentioned tubes as class B modulators.

•

Talk about your sky hooks, a 122-foot telephone pole was recently set by AT&T at one of its receiving stations at Forked River, N. J. The unusually high pole was needed in one of the receiving arrays for the ship-to-shore service of the company.

The shipment of the pole from the Pacific coast to the receiving location was no small feat. It was one of a shipment sent by water to Newark, N. J., and from there by train to Lawrenceville, N. J. One end of the 7500-pound stick was mounted upon a swivel-bolster telephone truck, and the center of gravity was supported on a swivel trailer that could be steered, hook and ladder fashion. The 85-mile trip from Lawrenceville to Forked River was negotiated by means of this special truck and trailer in two days.

•

Wonder how many of the gang heard that broadcast over the NBC Red network, Sunday afternoon, September 20, of the RCA "Magic Key"? Very interesting, you could hear them tune the receiver by the little "ping" that the crystal filter would let out. It didn't speak very well for ham radio as most of the dx stations—Switzerland, France, etc.—came through better than the W9 ham. The QRM covered most of his transmission. It sounded like a typical Sunday afternoon on 20-phone, the way his part of the program was re-broadcast over the network.

• Radioddities

A Long Island, N. Y., military camp has replaced the time-honored bugler with a p.a. system and bugle recordings. No doubt the equally long honored band is slated to go next.

•

RK1 is not Raytheon's first tube, but a Soviet call.

•

A. Call owns KLZZ.

•

Since we coined the word radioddities, there have been numerous approaches in other journals. The latest is a Los Angeles newspaper's *Radiodds And Ends.*

•

Two Dot is the name of a Montana town. Dit-dit!

•

To the aspirants for the worked all planets honor we offer Jupiter, Fla.; Sun City, Kans.; Eros, La.; Neptune, N. J.; Mars, Pa.; Moon Run, Pa.; Mercury, Tex.; Saturn, Tex.; and Venus, Tex.

•

While W8SWL was reading our article on the Rev. Mr. Stegall in the May issue, he tuned his receiver right across the voice of Mr. Stegall, OQ5AE, calling a W8.

•

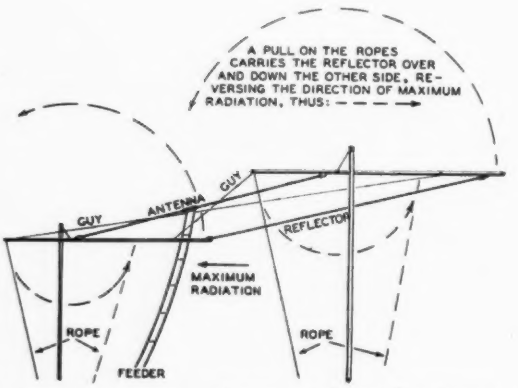
In a 28 Mc. contact, HK1JB in Santa Marta, Colombia, stated that he had often heard many loud ten-meter phone carriers during the summer when "selective fading" does not allow voice to be readable, although code might have been R9. If it were not for this fact, he would have had many satisfactory contacts with the U. S. during the past months. One way to reduce distortion due to selective fading is to hold the modulation percentage down below 75 per cent.

•

For the benefit of hams who desire to install stations at National Guard or Naval Reserve armories without jeopardizing their home licenses, it is pointed out that such separate stations may be licensed when of a military training nature either in the ham's name or in the name of some officer in charge who may not be a licensed operator. This is governed by Rule 366. Use the special application, Form 602, provided for the purpose.

THE "FLOP-OVER" BEAM

A simple antenna with reversible horizontal directivity and semi-variable vertical angle of radiation.



• We have seen a large number of antenna-directivity-changing arrangements but the one used by Harry Leonard, W6MBD, is about the most simple and the least expensive of them all.

The array itself consists of a half-wave doublet (fed in his case by a 600-ohm line and an RME antenna coupler) with a half-wave reflector spaced ¼-wave behind it. The reflector has been carefully resonated by the cut-and-try system so that the major lobe of radiation is strongly concentrated in the direction through the antenna.

The antenna and reflector are spaced by a pair of 12-foot light wooden separators. The reflector is mounted at one end of the two separators and the antenna proper is mounted about 8 feet in front of it and in line with the two supporting poles. This leaves about four feet at the end of each of the separators. Cross-bracing wires are run from these open ends of the separators across the system to the other side where they are tied. Also, the two control ropes are run from these open ends of the separators and down to the ground, where they are tied. The diagram shown herewith fully illustrates the simple mechanical construction of the array.

The whole arrangement is supported by four support wires (only two have been indicated, for the sake of clarity, in the diagram) and they are attached to the separators at the positions where the antenna and reflector are supported. These two wires at each end are run to the supporting poles. These wires are not of the same length; the shorter ones are attached to the separator poles at the positions where the antenna itself is attached. In this way the system, when rotated, will revolve more or less about the axis of the directly excited antenna.

By pulling on the support ropes it is possible to pull the reflector end of the antenna up, over, and then to allow it to come down on the other side. In other words the entire system is flopped over through 180°. Thus the major radiation lobe of the antenna has been swung around to the opposite direction.

The arrangement is much simpler than a rotatable "squirter" or "squisher," and is just as good if not better in its selected two directions of radiation. Also, it should make a very excellent bi-directional receiving antenna. The arrangement could very well be used for twenty by doubling the dimensions.

The directly-fed, half-wave antenna section can be excited by any of the common center-feed methods; the "Q" would be good, a delta-matched doublet would be very good and somewhat lighter than the "Q", twisted-pair could be used although its losses are somewhat higher than the other feed methods.

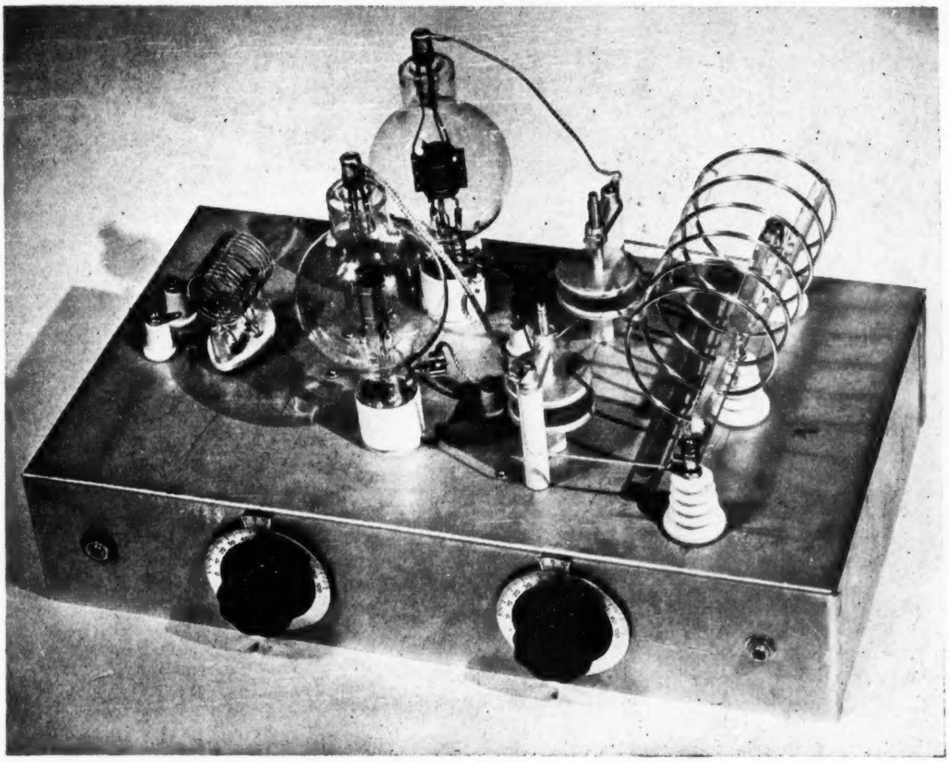
New Quirks

An excellent suggestion for a swamping resistor for a reasonably high-powered linear or grid modulated stage is sent in by W1BVN at Medford, Mass. Where it would be difficult to obtain a large enough bank of carbon or other non-inductive resistors to serve, a very effective substitute can be had through the use of a tungsten and a carbon filament lamp in series. A 40 watt tungsten and a 15 c.p. carbon serve in his particular case. This combination gives an almost constant resistance characteristic and is capable of dissipating enough power for quite a high-powered stage.

◆

Flasher buttons which fit under bulbs in regular sockets, and are cheap too, afford fb danger signals. A flashing red pilot can not be disregarded even by fellows who grow so accustomed to them that they become blin to regular danger lights.

• Top view of the amplifier with 100TH's in use.



THE "10-20" FINAL

By FAUST GONSETT, *W6VR

It becomes increasingly difficult to write an entirely different story for each improvement upon an old design. In this case it is a high-level push-pull amplifier. But there are some points in this particular design that make it somewhat different from the average type and well worth description.

In the first place it is an unusually neat and efficient layout of parts; second, it is designed specifically for operation on the 14 Mc. and 28 Mc. bands; and third, a number of different makes and types of tubes may be used merely by inserting the proper pair, no changes in the design being necessary.

You will notice that two small feed-through insulators are brought through the chassis for the grid leads. These same leads are connected, below chassis, to the normal grid terminal on the four-prong sockets. Thus, tubes of the 35T, RK37, T55, or 808 type may be used merely by inserting them and connecting the plate caps.

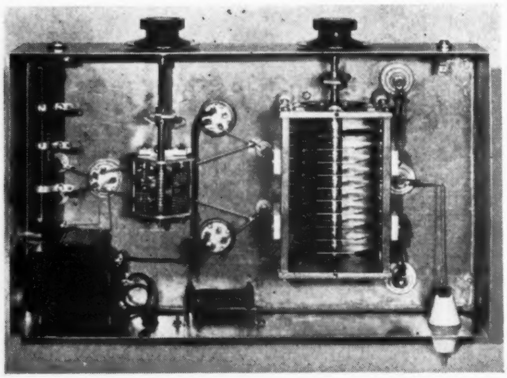
*Laboratorian, RADIO.

Also, tubes of the 100TH, HF100, RK38, or similar type may be inserted, for higher power operation, by connecting the side grid lead and connecting the plate caps.

Thus, the beginner, with a somewhat limited pocketbook, may start out with one of the less expensive types, and, as the outlook becomes more favorable, he may progress to the larger tube complement with no change in his final amplifier.

A Bi-Push exciter, or similar arrangement with 40-50 watts output on the 14 and 28 Mc. bands, will give ample excitation for the operation of any of the above-mentioned tubes at their full rated input. As a matter of fact, one of these exciters will give more than ample excitation for the smaller tubes. In this case the excitation may be reduced either by lowering the plate voltage on the exciter, by slightly detuning the crystal stage, or by using loose coupling between the exciter and the grid circuit of the final amplifier.

The circuit design is entirely conventional for



Bottom view of amplifier showing grid and plate tuning condensers.

an amplifier of this type. One thing might be mentioned; there is no r.f. choke shown in the photograph, either in the plate or grid circuits of the tubes. One is indicated in the circuit diagram as optional equipment for the plate circuit, since, with certain types of antenna coupling, it may be a help in keeping r.f. from entering the power supplies and associated equipment. It is not shown specifically because, with the most conventional types of antenna feed, two-wire lines and twisted pair feeders, it will not be needed. When something is not actually needed in a circuit, it is always best not to use it. However under some conditions when single-wire feed is being used, it may be advisable to incorporate this plate circuit choke.

The parts used in this amplifier seemed to fit in very nicely with under-chassis mounting. This type of mounting is desirable from the appearance standpoint and also because it allows the use of very short inter-connecting leads. A glance at the under-chassis view will show the unusual shortness of these leads. Another advantage of this type of mounting is dust cannot collect on the tuning condensers and other components where its presence would be undesirable.

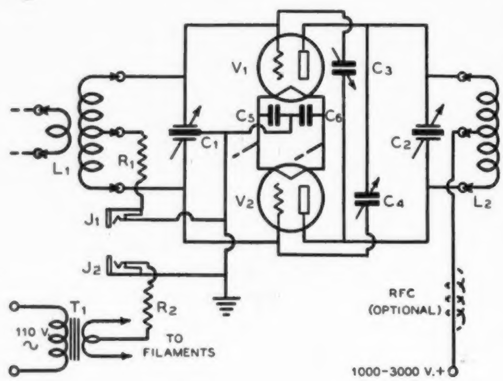
Circuit Constants

The filament transformer is mounted below-deck for the sake of appearance and short leads, and, instead of having its center-tap grounded in the conventional manner, a 100 ohm, 25 watt resistor is inserted between this lead and ground. This, in effect, puts a small amount of protective cathode bias on the tubes.

The grid bias resistor, which also acts in the capacity of an r.f. choke to isolate the center of the grid inductance from ground, is of 2500 ohms in resistance. Taps are provided to allow for the variations in grid bias required by different tubes or by the same tubes when operating at different plate voltages.

The plate tank condenser, a 50-μμfd. per section, 6000-volt affair, is also mounted below-chassis and is operated with its rotor insulated from ground. The grid condenser, with its rotor grounded, serves to determine the nodal point for the neutralizing circuit. Its capacity is 100 μμfd. per section, ample capacity to determine the nodal point and also ample to discourage any parasitics that might like to find a home.

The grid coils are by Decker and are wound with the link as an integral unit. The link terminals are brought out to the end of the chassis where they may be connected to the output of the exciter unit. Incidentally, those coils shown in the photograph are for 28 Mc. operation. The chassis is 10″ by 17″ by 3¾″ high, just the proper size for relay rack mounting.



SCHEMATIC DIAGRAM

C_1—100 μμfd. per section midget
C_2—50 μμfd., 6000 volts per section
C_3,C_4—800-type neutralizing condensers
C_5,C_6—.005 μfd. mica condensers
R_1—2500 ohms, 80 watts
R_2—100 ohms, 25 watts
J_1,J_2—Closed circuit jacks
L_1—Decker plug-in coils
L_2—28 Mc., 6 turns; 14 Mc., 10 turns
T_1—Filament trans., appropriate for tubes being used
V_1,V_2—See Text

In these days with 10 and 20 so hot, this little amplifier with one-half or one kw. input, dependent on which tubes are used, should really put your call up near the top of the w.a.z. list.

FIVE—TEN—TWENTY

• Crystal Controlled

By C. H. HUMES, W9THL

During the past few years there has grown up, among the ham fraternity, a persistent demand for a transmitter capable of effective operation on all three of the more popular "high frequency" amateur bands—namely 5, 10 and 20 meters. Although the problems involved in covering these three bands are in no way insurmountable, or even particularly discouraging, about the best that has been offered thus far has been a series of half-way compromises, whereby a rig originally designed for operation on the lower frequencies was robbed of half its power, most of its efficiency and all of its convenience, to obtain an anemic signal as high as 28 Mc. Just why everyone should shy away from multi-band, high-frequency units is not quite clear—especially in view of the tremendous activity now going on in the high-frequency area. But designers today seem to have the same fear of five meters that the whole ham world had of 100 meters some ten or fifteen years ago, when tubes were denuded of their sockets and dunked in oil, and condensers were carved and whittled to a mere skeleton of their former selves in a desperate effort to reach the new "high frequencies".

The complete transmitter mounted in an enclosed relay rack.

Be that as it may, the combination of five, ten and twenty presents too many genuine attractions to be overlooked any longer. Five meters offers an ideal opportunity for local rag chewing and experimentation without biting a large chunk out of the band for the fellow who wants to work dx, as well as the thrill of periodic "freaks" when signals suddenly pop in from a thousand miles hence,—and pop right out again! Ten and twenty are practically complementary for the dx hound, twenty generally being "hot" during the periods when ten is not, and vice versa. All in all, between the three of them they provide a pretty good cross-section of amateur activities.

The design of any multi-band transmitter presents certain well-defined requirements at the outset, and those requirements are much the same for 5, 10 and 20 meters as they are for any series of lower frequencies.

First, the rig should be capable of both c.w. and phone on all of the several bands within its scope, or a part of its potentialities are wasted. Band changing should be easy and quick, for if it isn't, or if the tuning requires a couple of hours of juggling after the band changing has been completed, the whole system might just as well be eliminated at the start. No ham wants to spend half his operating time coaxing refractory circuits into operation on new frequencies. If he can't get from where he is to where he wants to be, without a couple of hours of fiddling and swearing, he'll stay where he is and do his swearing without the fiddling, whenever the band goes dead. In other words, he gets it steamed up on one frequency and there it stays, and band-changing goes by the board.

Complete operation should be controllable from the front of the panel, and from the operating position too, if conditions require that it be located more than an easy arm's reach

Figure 1. The exciter stages.

from the transmitter, and provisions should be made to accommodate at least the more usual antenna types at the final stage.

These are the very same principles that guided Gerry Cole in designing "Progressive III", the five band rig for 10 to 160 meters, described in an earlier issue*, and indeed, the "5, 10 and 20" might very well be said to be simply a logical offspring of the larger unit. Operation, layout and constructional details are much the same.

The Beam Tetrode Oscillator Stage

The success of the 6L6 beam tube in "Progressive III" recommended its incorporation in the oscillator stage of the new rig, although this time in a regenerative or resonant-cathode circuit instead of the straight tetrode connection. This circuit, based on the old principle that a cathode circuit which is capacitively reactive will produce regeneration over a broad frequency range, is deserving of more attention than it is receiving. Capable of considerably more output than the straight tetrode or pentode connection, it relieves the crystal of all but a fraction of its r.f. current, lowering its temperature and avoiding much of the drift that otherwise occurs when these oscillators are pushed for output.

There are points about its operation, however, which should be understood. To begin with, the cathode capacity, which is shunted across the r.f. choke, is more critical than is generally supposed, and the optimum value on one band may not be optimum on another. In fact, it may not even be suitable, and when it isn't suitable the circuit has a tendency to oscillate merrily on its own hook, completely oblivious of the crystal, or else to stop oscillating entirely. Either of these are bad habits, but they are easily remedied by using a variable instead of a fixed capacity. In the present transmitter we found that practically all of a .00005 μfd. condenser was required with a 40 meter crystal, whereas about half of that value was best for 20 meters. This circuit is also capable of high harmonic output, the plate circuit simply being adjusted to the desired har-

*"Progress As You Prosper," C. H. Humes, W9THL RADIO, June, 1937.

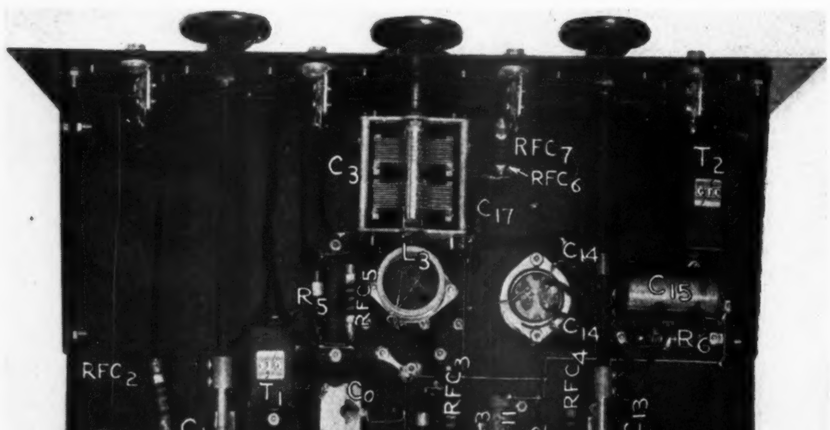


Figure 2. Bottom view of the exciter deck. The various sockets, resistors, condensers, etc., have been marked to correspond with the schematic diagram.

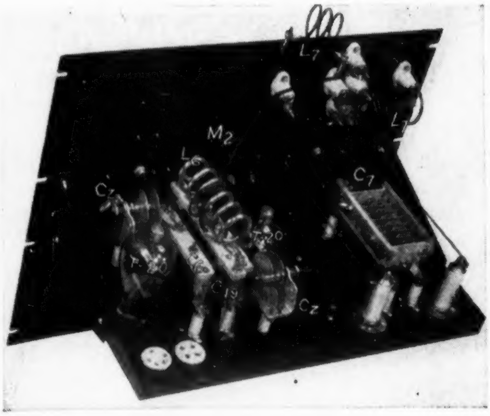


Figure 3. The push-pull T-20 final amplifier.

monic frequency of the crystal. Oscillator harmonics are not used in the present transmitter, however, for reasons indicated in the following paragraph.

A second 6L6 is used in the following stage, as a buffer and frequency multiplier. Capacitively coupled to the oscillator stage, it is operated always as a doubler to avoid a persistent tendency toward self-oscillation when its plate circuit is tuned to the same frequency as the oscillator plate. This, of course, means an additional crystal for twenty meter operation, but that is both cheaper and more convenient than neutralizing expedients in that particular spot.

A T-20 Driver Stage

The plate of the buffer stage is link-coupled to the grid of the driver—a Taylor T-20—operating with 750 volts on the plate. Properly adjusted, the buffer will deliver from 25 to 30 ma. to the grid of the T-20 when the T-20 is unloaded, and will deliver it at any of the operating frequencies.

Oscillator, buffer and driver stages are combined on a single chassis. Plate tuning elements of the first two, and the grid circuit of the third stage are all mounted where they belong—below decks, leaving the top-sides clear of everything except the plug-in elements and the plate circuit of the driver. This construction yields not only a clean appearance but shorter and more efficient wiring as well.

Figures 1 and 2 show a bird's and worm's eye view, respectively, of the complete exciter, and give a pretty clear picture of the high wiring-efficiency that has been obtained. The rather unorthodox procedure of setting the driver stage between the oscillator and buffer is justified by the economy of lead-length it affords, as well as by general balance of mechanical design.

The Push-Pull T-20 Final

The final stage, consisting of a pair of T-20's in push-pull, occupies a position directly above the exciter unit. Its grid circuit, placed on the under side of the chassis, is coupled to the driver by a short link which is paralleled instead of twisted, in deference to the theoretical losses occurring in twisted pair at 56 Mc. The mechanical design of this push-pull stage is particularly good, and is recommended to the readers' careful attention. The tube sockets are mounted, one on either side of the tank condenser, and sunk below the chassis. Grid leads are thus reduced to approximately one inch, going from each side of the condenser directly to the socket. Neutralizer leads go through the chassis to the condensers mounted directly above, and the plate leads are brought from each side of the plate tank condenser directly to the plate-caps of the tubes. Everything is straight, short and as ship-shape as a racing yacht.

The general symmetry of design and short leads have reduced the stray capacities to such a low value that once the rig is neutralized—on any band—it stays neutralized, not only for that particular band, but for all bands. This

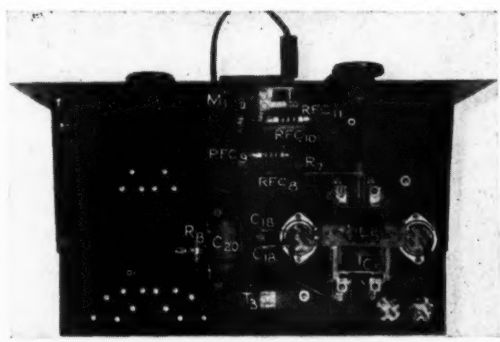


Figure 4. Bottom view of the final amplifier chassis

simply means that once the neutralizing condensers are set they may be forgotten—band changing is accomplished with only the plug-in and tuning elements being involved.

Antenna Tuning

Occupying the remainder of the chassis is that handiest of gadgets, the antenna tuner, brain-child of the designer, first introduced in the description of "Progressive III" published in the June, 1937, issue of this magazine. Pro-

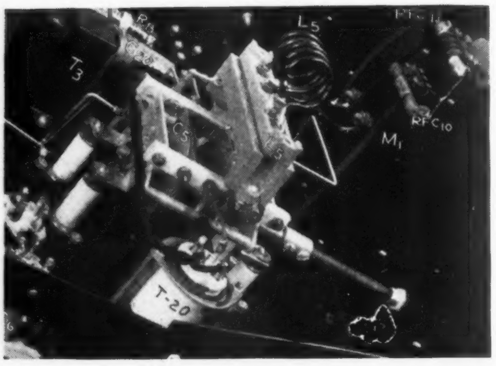


Figure 5. Closeup of the bottom of the final stage showing the grid circuit of the T-20's.

vided with proper plug-in coils, this tuner will couple the final stage to just about anything in the way of an antenna that the ingenious ham can put up. For a more complete description of its construction and the things of which it is capable, we refer you to the article mentioned before.

Top and bottom views of the output chassis are shown in figures 3 and 4, respectively, and for those who are constructional-minded there is an additional view, figure 5, which is a closeup of the under, or grid side of the final. In all these photographs, the stages are equipped with coils for 56 Mc. operation.

Complete metering of all r.f. stages, with the exception of the grid of the final, is accomplished by a single 0-250 ma. milliammeter equipped with plug and extension cord. Grid and plate circuits are provided with jacks and can be metered by the simple process of plugging-in. The final grid is provided with its own 0-25 ma. meter.

Power Supplies

Power for the r.f. sections is obtained from two separate supplies, mounted side by side on a single chassis. They deliver well regulated output voltages of 480 and 750 volts; one for the exciter stages, with appropriate taps for the 6L6's, and one for the final stage alone.

Figures 6 and 9 are the top and bottom views of this power stage. Note again the neat mechanical arrangement of parts, and the resulting ease of wiring.

Modulation is accomplished by a 30-watt, high-gain amplifier employing push-pull parallel 6A3's in the output. This unit is built separately, and not included in the rack and panel assembly, in order that it might be used for other speech-amplification requirements, should they arise. It can, of course, be built in the rack if desired, assuming that proper precautions are taken to prevent feedback.

Complete wiring diagram of the transmitter proper, with list of parts, is shown in figure 8. The various component parts are numbered on the complete wiring diagram and have corresponding numbers on the various illustrations for easy identification of the circuit parts.

For those who have been inspired by this literary masterpiece to build a "5-10-20" for themselves, a few constructional and operating notes would not be amiss. In constructing the various stages, assemble chassis and panel separately, bolting panel to chassis only long enough to align properly the condenser mount-

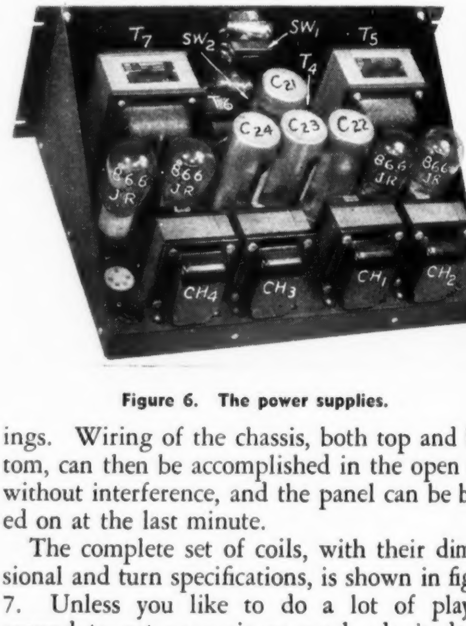


Figure 6. The power supplies.

ings. Wiring of the chassis, both top and bottom, can then be accomplished in the open and without interference, and the panel can be bolted on at the last minute.

The complete set of coils, with their dimensional and turn specifications, is shown in figure 7. Unless you like to do a lot of playing around to get your rig to work, don't depart from the specifications listed, and don't try to substitute the tank condensers listed with ones you have lying around the shack. When you're covering from 14 to 56 Mc. with the one set of tank condensers there isn't much room for compromises, and you're just looking for large doses of grief when you try them. All in all, Cole has done a pretty thorough job of engineering and design and you will do well to follow specifications exactly.

A tuning chart is attached to the panel of the final stage. Since neutralization is sufficiently effective to require no readjustment during band-changing, condenser settings can be logged and will stay the same. It's a mighty handy assistant for quick changes.

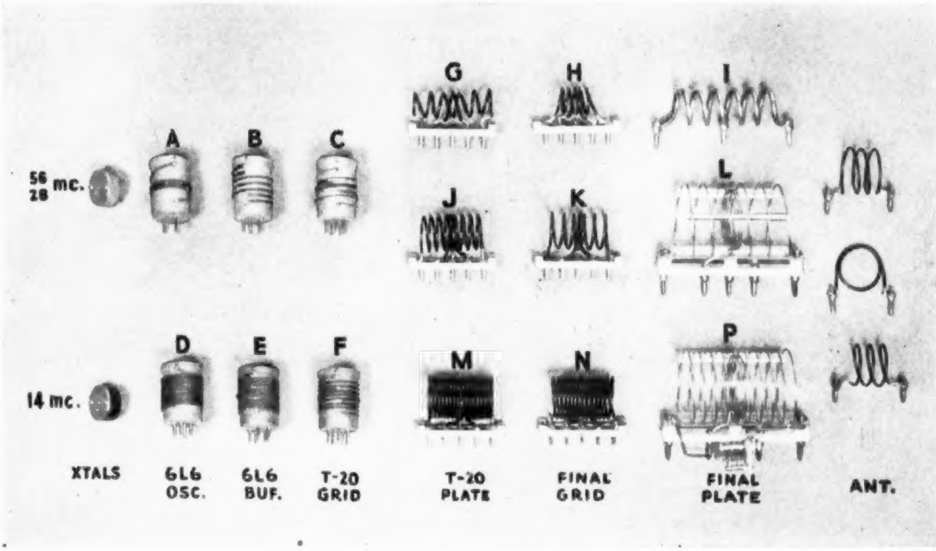


Figure 7. The complete coil complement.

COIL DATA

	BAND	14 mc.	28 mc.	56 mc.
	CRYSTAL	7.0 mc.	14 mc.	14 mc.
L_1 6L6 OSC.	Coil Number	D	A	A
	No. Turns	18	6	
	Wire Size	22 DCC.	22 DCC.	
	Coil Form	XR-4	XR-4	
	Winding Length	1½"	½"	
L_2 6L6 Buffer	Coil Number	E	B	B
	No. Turns	10	3	
	Wire Size	22 DCC.	22 DCC.	
	Coil Form	XR-5	XR-5	
	Winding Length	1½"	1½"	
	Link Turns	1	1	
L_3 T-20 Grid	Coil Number	F	C	C
	No. Turns	8	4	
	Wire Size	22 DCC.	22 DCC.	
	Coil Form	XR-5	XR-5	
	Winding Length	1½"	1½"	
	Link Turns	2	1	
L_4 T-20 Plate	Coil Number	M	J	G
	No. Turns	18	8	6
	Wire Size	10 Enamel	10 Enamel	10 Enamel
	Coil Form	PB-5	PB-5	PB-5
	Winding Length	2½"	2½"	2½"
	Inside Diameter	1-7/16"	1-7/16"	11/16"
	Link Turns	1	1	1
	* (All Air Wound)			
L_5 P.P. T-20 Grid	Coil Number	N	K	H
	No. Turns	14	8	4
	Wire Size	10 Enamel	10 Enamel	10 Enamel
	Coil Form	PB-5	PB-5	PB-5
	Winding Length	2½"	2½"	1½"
	Inside Diameter	1-7/16"	1-3/16"	11/16"
	Link Turns	1	1	1
	* (All Air Wound)			
L_6 P.P. T-20 Plate	Coil Number	P	L	I
	No. Turns	10	6	6
	Wire Size	no. 14	no. 14	3/16" Cop. Tube
	Coil Form	Coto 20BTVL	Coto 10BTVL	
	Winding Length	4½"	4½"	4½"
	Inside Diameter	2¾"	2¾"	1⅛"
	Link Turns	3	3	2
	Link Wire Size	no. 14	no. 14	no. 10

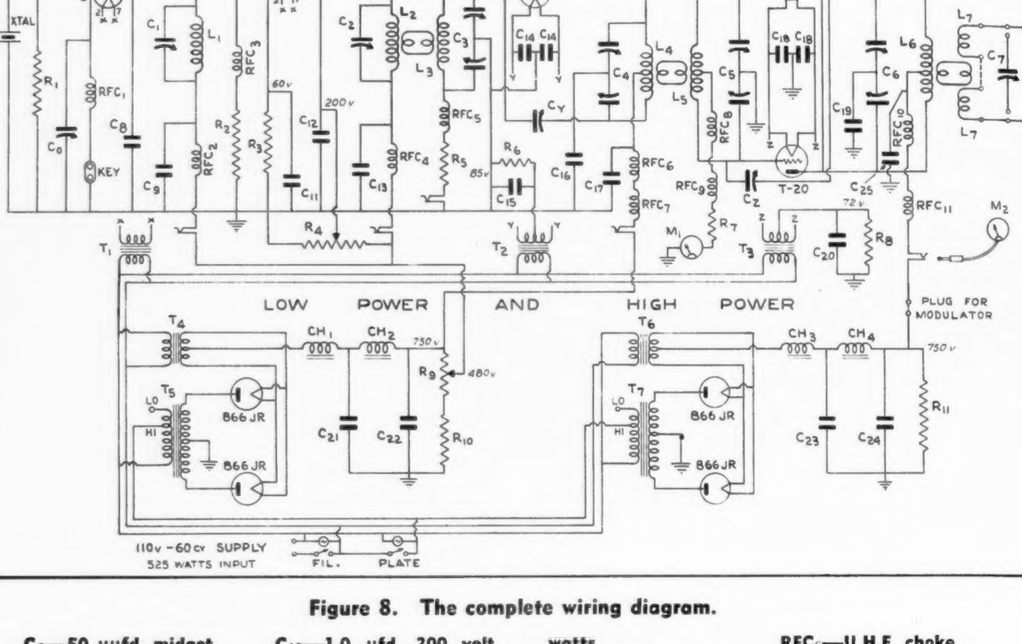


Figure 8. The complete wiring diagram.

C_0—50 μμfd. midget
C_Y—5 μμfd. neutralizing
C_1—50μμfd. midget
C_2—50 μμfd. midget
C_3—150 μμfd. per section Split stator
C_4,C_5—50 μμfd. per section split stator
C_6—35 μμfd. per section, 2000 volts
C_7—35 μμfd. midget
C_8, C_9 .001 μfd. mica
C_{10}—.0001 μfd. mica
C_{11}—0.1 μfd. 600 volt tubular
C_{12}, C_{13}—.001 μfd. mica
C_{14}—2-.001μfd. mica
C_{15}—1.0 μfd. 200 volt tubular
C_{16},C_{17}—.001 μfd. mica
C_{18}—2-.001 μfd. mica
C_{19},C_{20}—.001 μfd. mica
C_{21}, C_{22}, C_{23}, C_{24}—2 μfd. 1000 volts
C_{25}—.001 μfd. mica
C_Z—Neutralizing condensers
R_1—50,000 ohms, 2 watts
R_2—2500 ohms, 10 watts
R_3—500 ohms, 10 watts
R_4—40,000 ohms, 50 watts
R_5—2500 ohms, 10 watts
R_6—200 ohms, 25 watts
R_7—4000 ohms, 10 watts
R_8—2000 ohms, 25 watts
R_9—2000 ohms, 100 watts
R_{10}—25,000 ohms, 25 watts
R_{11}—25,000 ohms, 50 watts
$RFC_{1,2,3,4,5}$ — 2½mh., 125 ma.
RFC_6—U.H.F. choke
RFC_7—2½ mh. 125 ma. choke
RFC_8—U.H.F. choke
RFC —2½ mh., 125 ma. choke
RFC_{10}—U.H.F. choke
RFC_{11}—2½ mh., 125 ma. choke
Coils—See coil table
T_1,T_2—Filament transformers
T_3—7.5 volt, 5 amp. trans.
T_4—2.5 volt, 10 amp. trans.
T_5—Plate transformer
T_6—2.5 volt, 10 amp. trans.
T_7—Power transformer

A final word on tuning. A stage that is doubling shows a comparatively high minimum current at resonance, even when the plate circuit is unloaded. Plate efficiency is high in all stages of this rig, and unless you are doubling purposely, be sure that the plate current goes well down toward zero at the no-load resonance point.

A picture of the "5-10-20", all dressed up in a handsome enclosure, is shown at the head of the article. This rig, in operation for several monts at W9TXU, has been doing splendid service on all three bands. During the annual yacht race from Chicago to Michigan City, Indiana, this year, it was installed at W9ZBX, on the top of the Chicago Board of Trade Building, and was monitored constantly in Michigan City, on 56 Mc. during the entire race.

It is the writer's belief that this transmitter should fill a definite niche in the progress of

[*Continued on Page 88*]

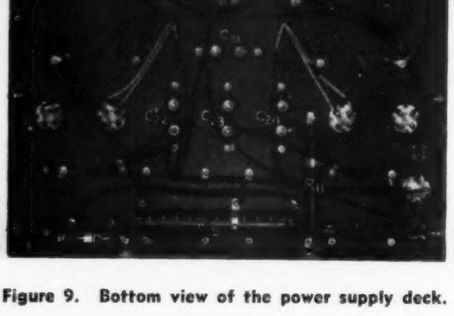
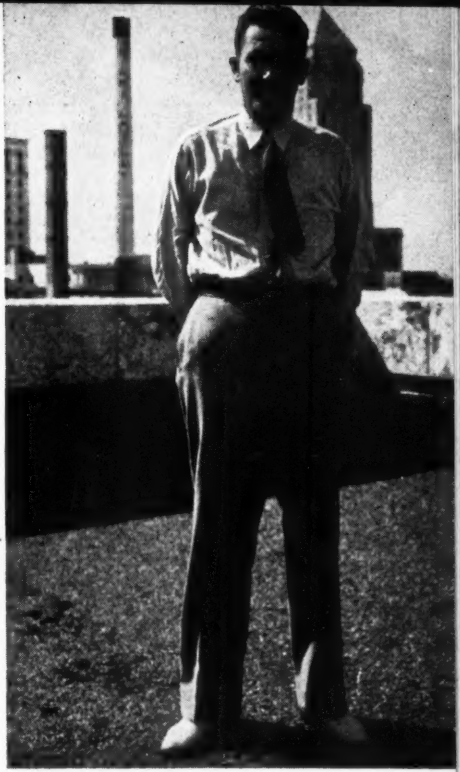


Figure 9. Bottom view of the power supply deck.

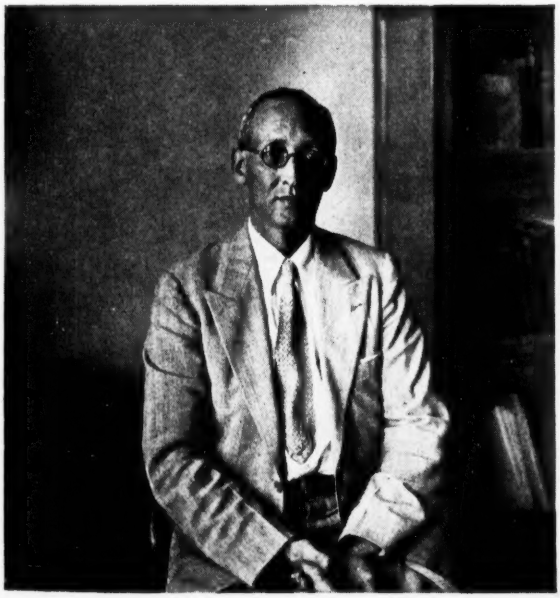
Meet the R. I. --

• RADIO herewith presents a few of the U.S. radio inspectors in charge, thus showing the newcomer that the "R.I." is not necessarily a "ham harasser" but is or has been a ham himself.

Believe it or not, George S. Turner of the 6th district is W4COP. He does not appreciate the implication contained therein and wants it known that the call was not requested but was given to him in the regular course of alphabetical assignment.

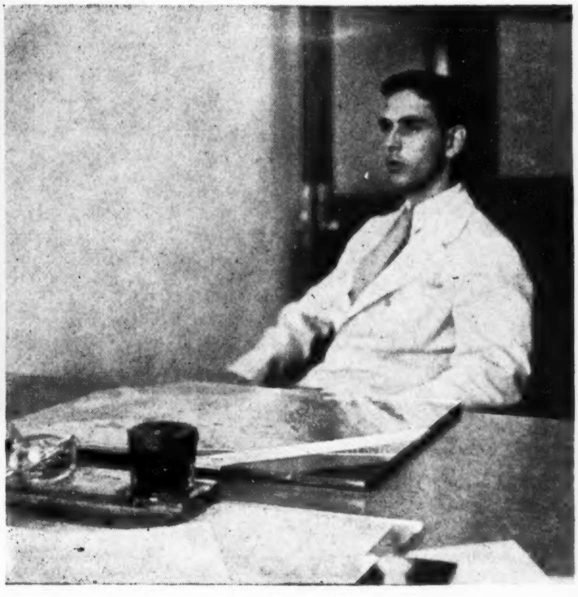


Joe H. McKinney, at one time of Cherry Valley, Arkansas, now lives in Miami, Florida, where he is 7th radio district inspector. A former navy man, he was a commercial operator before he joined up with the F.C.C.



Theodore G. Deiler, 8th district inspector, is in New Orleans, Louisana, where they occasionally have to stop ham radio for Creole cooking and Mardi Gras festivities.

Frank M. Kratokvil, W5FCA, (ex-9PG and 8BA), has been a radio inspector since 1928. He is now stationed in the 10th district. He received his electrical engineering degree from Armour Institute in 1931.



TWO NEW TUBES

•

The 833

RCA has announced a new type of u.h.f. power tube that should really give good output in the range from 7 to 100 Mc. The only disadvantage of the new tube is that its price is somewhat above the average amateur's capabilities. However, some of the high power boys will undoubtedly be interested in it.

The photograph alongside gives an idea as to the unusual design features of the new tube. In the first place, the tube is quite short in length; it is only 8⅝″ overall. Secondly, the grid and plate are both brought out through the top of the envelope with unusually short and heavy connecting leads. This allows the unusually short neutralizing leads needed for a u.h.f. amplifier. Third, a high-wattage, multiple V filament is used. This gives the tube an extremely high transconductance.

It is rated for full operation at 30 Mc. and can be operated at reduced output to 100 Mc. It will undoubtedly give good output throughout the u.h.f. television channels.

Tentative Characteristics

Filament voltage (a.c. or d.c.)	10.0 volts
Filament current	10 amps.
Amplification factor	35
Direct interelectrode capacities	
Grid-plate	6.3 μμfd.
Grid-filament	12.3 μμfd.
Plate-filament	8.5 μμfd.

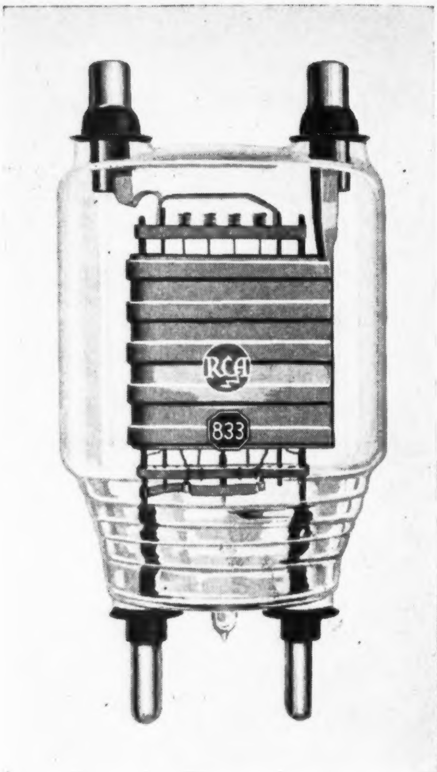
Typical Operating Conditions—Class C Telegraphy

D.c. plate voltage (max.)	3000 volts
D.c. grid voltage (max.)	-500 volts
D.c. plate current (max.)	500 ma.
D.c. grid current (max.)	75 ma.
Plate input (max.)	1250 watts
Plate dissipation (max.)	300 watts

Typical Operation

D.c. plate voltage	2500	3000 volts
D.c. grid voltage	-200	-200 volts
Peak r.f. grid voltage	390	360 volts
D.c. plate current	475	415 ma.
D.c. grid current (approx.)	65	55 ma.
Driving power (approx.)	25	20 watts
Power output	925	1000 watts

Due to the tube's unusually high transconductance, it will be quite easy to excite. This is an especial advantage when operating in the ultra-high range, as many experimenters have discovered.



The 833—high transconductance; large power handling capabilities.

•

The 6Y6G

Another new tube has just been announced by the tube manufacturers. This one should be of some interest to the amateurs who necessarily are restricted to 110 v. d.c. as their plate supply. The tube is called the 6Y6G; has a 6.3 volt, 1.25 ampere heater; and is a beam tetrode designed to operate from a maximum plate voltage of 135 volts d.c.

Single-tube Class A Amplifier

Plate Voltage	135 max. Volts
Screen Voltage	135 max. Volts
Grid Voltage	—13.5 Volts
Peak A-F Grid Voltage (Appr.)	13.5 Volts
Transconductance	7000 Micromhos
Zero-Sig. Plate Current	58 Milliamperes
Max.-Sig. Plate Current	60 Milliamperes
Zero-Sig. Screen Current	3 Milliamperes
Load Resistance	2000 Ohms
Distortion:	
Second Harmonic	2.5%
Third Harmonic	9.0%
Power Output	3.6 Watts

As a class A amplifier, one or a pair of these tubes should make a very good modulator for a low-powered 110-volt-operated phone rig.

One of them should be especially useful as a crystal oscillator tube with one of the new u. h. f. crystals. The crystal current would be unusually low due to the very low plate voltage required for the tube's operation.

Reviewing . . .

U. H. F. PROPAGATION

•

H. H. Beverage, Chief Research Engineer of RCA Communications, Inc., herein provides information on propagation characteristics of ultra high frequencies above 30 Mc. Much of it has been presented in papers offered before section meetings of the I.R.E. and in the RCA Review for Jan., 1937.

•

By H. H. BEVERAGE

The propagation characteristics of ultra high frequencies above 30 megacycles have been studied for many years. While many observations have been made, it is unfortunate that a substantial proportion of these observations have been qualitative only, due to the difficulty in constructing suitable equipment for quantitative measurements. It has also been difficult to build transmitters of sufficient power and stability to make possible the quantitative measurement of signals at considerable distances beyond the horizon. It is the purpose of this paper to review some of the available information concerning ultra high frequency propagation, including some studies which have recently been made by engineers of R.C.A. Communications, Inc., of propagation at various frequencies both within and beyond the optical distance.

The study of ultra high frequency propagation falls logically into three devisions, namely, (1) Propagation within the optical distance; (2) Ground Wave propagation beyond the horizon; (3) Sky Wave propagation.

Propagation Within Optical Distance

The theoretical laws of ground wave propagation over optical paths are fairly well known. Several excellent papers have been published on this subject.[1-2-3-4-13-14] (See bibliography at end of article.) It has been shown that the received signal is the resultant of the direct ray and a ray reflected from the ground. For most practical cases the reflected ray impinges upon the ground at nearly grazing incidence and is usually reflected at high efficiency with a 180-degree phase reversal. Consequently, the direct ray and the reflected ray arrive at the receiving antenna at equal intensity and nearly out of phase. The phase difference between the two paths depends upon the location of the transmitting and receiving antenna and the nature of the intervening ground. For flat ground, Trevor and Carter[1] have shown that the phase difference for grazing angles is

$$\Psi = \frac{4\pi a h}{\lambda r} \qquad (1)$$

where h is the height of the transmitting antenna, in meters

a is the height of the receiving antenna, in meters

r is the distance, in meters

λ is the wavelength, in meters.

The direct field E_0 from a half-wave dipole is $7(\sqrt{W}/r)$, where W is the watts radiated. The received field for grazing angles then becomes,

$$E = \frac{7\sqrt{W}}{r} \times \frac{4\pi a h}{\lambda r}$$

$$= \frac{88\sqrt{W}ah}{\lambda r^2} \text{ volts per meter} \qquad (2)$$

From equation (2), it will be noted that for the conditions assumed, the signal intensity is inversely proportional to the square of the distance; is directly proportional to the heights of the transmitting and receiving antennas above ground; and is inversely proportional to the wavelength. For a given height for the receiv-

ing antenna, the transmitting antenna height must be proportional to the wavelength to obtain a given signal intensity. For a given wavelength, the signal intensity will increase directly in proportion to the increase in height of either the receiving antenna or the transmitting antenna. For given antenna heights, the signal intensity will be proportional to frequency. All of these factors are favorable to the use of higher frequencies.

The above simple equation applies only for grazing incidence over flat land, free from obstructions. If both the transmitting and receiving antennas are high and fairly close together, as, for example, transmission from the Empire State Building to an airplane, or between the tops of the Empire State Building and the RCA Building[14], the geometry is such that the difference in path length is no longer a small fraction of a wavelength, and the simple equation no longer holds. In general, standing waves occur which may be greatly complicated by reflections from more than one point. The observations on the signals from the Empire State Building with the receiver in an airplane over North Beach, Farmingdale and Patchogue, as reported by Trevor and Carter[1], clearly show and explain these phenomena.

If the transmission takes place over sea water, there should be a marked difference between vertical and horizontal polarization. For sea water, horizontally polarized waves are reflected nearly 100 per cent for all angles, and the phase shift changes gradually from 180 degrees at grazing incidence to about 178 degrees at perpendicular incidence. On the other hand, for vertically polarized waves, the phase angle and per cent reflection change very rapidly with the angle of incidence so that transmission over sea water should be excellent.

Trevor and Carter reported on some propagation measurements over sea water transmitting from an antenna a few feet above the water to a motor boat.[1] They found that the propagation of horizontally polarized waves was extremely poor as compared with vertically polarized waves, as predicted by the theory given in their paper. On the other hand, when the antennas are located at considerable elevations on mountains, as was the case during some observations between the islands of the Hawaiian group several years ago,[5] it was found that there was no marked difference between horizontal and vertical polarization, even though the transmission path was mostly over sea water and distances greater than the optical path were involved.

In applying equation (2), it is obvious that if the transmitting antenna is directive, either in the horizontal or vertical plane, or both, the directivity factor should be taken into account, since the equation was developed on the basis of transmission from a simple half-wave dipole.

Ground Wave Propagation Beyond the Horizon

Comparatively few data are available for determining the laws of ultra high frequency propagation beyond the horizon. Handel and Pfister[6] in a recent paper (published in German) have shown that the penetration of ultra short wave radiation beyond the range of optical sight takes place due to both diffraction and refraction. They state that the field due to diffraction at the earth's surface is independent of diurnal and seasonal times. Methods for calculating the diffraction field together with calculated curves and some measured values are included in their paper. The calculated diffraction fields agree very well with the observed fields in most instances, but at times the observed fields beyond the horizon are shown to be considerably higher than the values calculated from the laws of diffraction. The authors attribute this to refraction phenomenon, apparently within the troposphere. The refraction field shows strong variations and produces an effect similar to fading in short wave reception, whereas the field intensities in the diffraction zone are very stable. The authors point out that the refraction fields appear more frequently and strongly in summer than in winter and that the refraction over sea is stronger than over land.

Ross Hull[7] has made some very interesting studies of the refraction field and has shown that there is excellent correlation between signal intensity and temperature inversion. That is, when warm air masses exist above colder air masses near the ground, the signals are refracted down to earth beyond the horizon by the warm air. The existence of the warm air masses is determined by temperature measurements with balloons or airplanes. Considerably more data are required before it will be possible to evaluate these refraction fields or to predict their frequency of occurence.

It may be of interest to examine some of the available propagation data which include the

refraction fields beyond the horizon as evidenced by fading.

Observations were made by Mr. G. S. Wickizer on the signals from the Empire State Building operating on a frequency of 41 megacycles with about 1200 watts in the antenna. The transmitting antenna was about 1300 feet above sea level. The receiving antenna was a dipole mounted on a bamboo pole, the center of the dipole being 17.6 feet above the ground. By substituting the above constants in equation (2) with distance as a variable, a curve of slope $1/D^2$ was obtained. Beyond the horizon the field intensity falls off faster than the inverse square of the distance. A curve with a slope proportional to $1/D^{3.6}$ seems to fit the observations fairly well, even at the maximum distance measured, 100 miles.

The observed intensities come up to the calculated curve frequently, but seldom exceed it, except in a few cases such as the points taken at Arney's Mount, where the receiver was on a high hill unobstructed in the direction of the transmitter. Most of the observations lie between the calculated curve and a similar parallel curve drawn at 10 per cent of the intensity of the calculated curve. The average intensity appears to be about one-third of the calculated intensity. Beyond the horizon, the scattering is probably largely due to fading of the refraction field, as it was found to be difficult to check the readings by returning to the same observation points at different times.

Within the optical distance, the attenuation is probably relatively high due to large buildings and other obstructions. Burrows, Hunt and Decino[3] have shown that the average fields in the city of Boston on a frequency of 34.6 megacycles follow the inverse square law but average 10 to 12 db below the calculated terrain values.

Holmes and Turner[8], on the other hand, have shown that under some conditions, the observed attenuation in urban areas does not seem to fit the inverse square law very exactly. They also show that the attenuation increases markedly with frequency, so that 100 megacycles is considerably inferior to 30 megacycles in an urban area, whereas equation (2) indicates that the optical path transmission should be better on the higher frequency in the absence of obstructions. It should be noted, however, that the transmitting antenna used by Holmes and Turner was only 190 feet above the ground. Somewhat different results might have been obtained if the transmitting antenna had been at a greater elevation so as to clear the obstructing buildings more effectively. Nevertheless, the survey reported by Holmes and Turner indicates very definitely that in the presence of obstructions, the attenuation increases greatly as the frequency is increased.

Another set of observations for an entirely different transmitting condition, but with nearly the same frequency as used by Mr. Wickizer, mentioned above, will be of interest. The transmitter was located on top of the RCA Building at 30 Rockefeller Plaza in New York City. The antenna was about 980 feet above sea level and was *horizontally* polarized. The power in the antenna was about 80 watts. The calculated curve for inverse square law up to the horizon and inverse 3.6 power law beyond the horizon, again seems to fit the maximum signal intensities fairly well, even out to 180 miles.

Observations were made by B. Trevor and R. W. George on the much higher frequency of 91.8 megacycles. The antenna was a simple half-wave dipole on the roof of the Continental Bank Building at 30 Broad Street, New York City. The antenna was about 600 feet above the street level. The power in the antenna was about 50 watts. The antenna was readily adjusted to radiate either horizontally or vertically polarized waves. The receiving antenna was a dipole rigged on the roof of a car, the center of the dipole being about ten feet from the ground.

Beyond the horizon a curve with a slope of $1/D^5$ seemed to fit the maximum points with the exception of the points measured on top of hills. There was apparently no consistent difference between the transmission characteristics of horizontal and vertical polarization over land.

Observations on transmission from the top of the RCA Building with a frequency of 25.7 megacycles indicate that the signal beyond the horizon falls off about as the 3.2 power of the distance.

Airplane observations on a frequency of 411 megacycles reported by Trevor and George[9] indicate that the signals fall off approximately as the 9th power of the distance beyond the horizon.

Figure 1 shows the observed rates of attenuation beyond the horizon plotted against frequency. The factors determined for the four frequencies fall on a smooth curve, but the

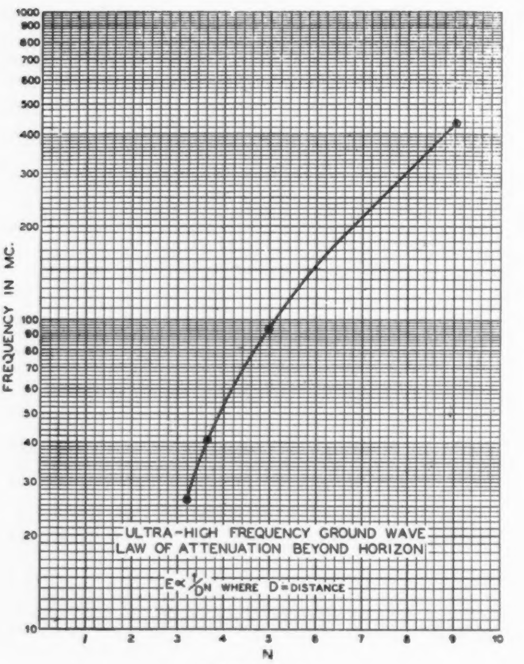


FIGURE 1

data are too few to warrant much confidence being put in this curve. The curve does indicate, however, that the attenuation beyond the horizon increases rapidly for the higher frequencies. Perhaps the attenuation law changes for increasing distance beyond the horizon, but there are insufficient data to indicate whether this is so or not. When higher powered transmitters become available, the attenuation laws beyond the horizon can be determined more accurately.

Sky Wave Propagation

As the frequency is increased, a point is eventually reached where the sky wave is not bent sufficiently to come back to earth. This is an advantage for certain services, such as television, as there is essentially only one path and multiple images are absent. It is also possible to duplicate the frequencies at moderate distances without fear of interference. The lowest frequency that will just fail to have the sky wave returned to earth depends upon several factors. In general, the higher frequencies are returned to earth in the early afternoon. Contrary to what one might expect, there is some evidence that the high frequency sky waves are transmitted better in winter than in summer, particularly over the north Atlantic path[10]. The transmission also is apparently associated with the 11-year sunspot cycle. For example, the high frequency sky waves were getting through quite frequently during 1927 and 1928 when extensive observations on frequencies above 30 megacycles were first made. Subsequent to 1928, high frequency sky wave transmission was relatively poor until the spring of 1935. Accordingly, there is relatively little information available concerning the transmission of very high frequency sky waves. The long distance transmission on these frequencies is very irregular, which adds to the difficuly of obtaining consistent data. As the frequency is raised, the sky wave transmission becomes more and more erratic. Above about 45 megacycles, the sky wave transmission rarely appears to occur, and when it does occur, it tends to appear as a "burst." That is, the signal comes up very suddenly, remains fairly strong for a few seconds or even minutes, and suddenly disappears, perhaps not to be heard again over that particular path for months. This "burst" phenomenon was apparently first observed by W. I. Matthews on 50 megacycles over a distance of about 240 miles.[5]

In May and June, 1935, amateurs reported hearing 5-meter signals over a distance of 900 miles. Amateurs in the vicinity of Chicago heard several New England amateurs working in the 50-60 megacycle band, and at least one two-way contact was established.[11] A similar effect was reported for May 9, 1936.[12] On this occasion, several two-way contacts were made between East Coast and Middle West amateurs. Many signals were heard over a period of some three hours, beginning at approximately 8:30 p.m. Several of the amateurs reported severe selective fading, with part of the signal dropping out and the rest remaining. These conditions occurred again May 14 and 15, 1937.

It seems probable that the transmissions on these occasions were due to sky waves and not refraction. Probably the suggestion that the signals were bent down by "unusually heavy sporadic E-region ionization" is the correct explanation.

From the available information, it would seem that little sky wave transmission takes place above about 45 megacycles, and that such transmissions that do occur above 45 megacycles are produced by unusual ionization conditions which probably will rarely occur. Amateur operators spread over a wide area are in an excellent position to observe these sporadic transmissions and their observations should be extremely valuable for indicating the location.

[*Continued on Page 74*]

Designing a
TEN-METER SUPERHET

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The author gives the whys and wherefores for "making it really perk."

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By GEORGE MERRIMAN,* VS6AH

If you were blessed with unlimited wealth and could afford any whim whatever; and you were in search of the world's best in ten-meter supers, how would you design it?

Obviously you would not just go and buy one offhand. Supers sold in shops are generally good, but they show up badly on 28 Mc. Of course, they do work after a fashion on that frequency, but they seem to lack life, vim, sock! The reason is, of course, that the modern communications receiver tries to do too many things and cannot do them all equally well. It is usually "ten" that suffers.

Look over an up-to-the-minute, 1937, all-band super manufactured for tired amateurs who cannot be prevailed upon to build their own. If you inspect it critically, you will see that the manufacturers have made it with several very definite views in mind: it must be foolproof; it must have single-dial tuning on any band from 1.5 to 28 Mc., because the man who is going to use it is modern and inferior; he cannot spin two dials like the old timers. Plug-in coils? Gosh! they're right out of the picture, so they use coil switching. But you would not use coil switching on the ten meter band, or would you?

Well, what of the manufacturers? They hire good research engineers to find out all about it; surely they have come to some decision? But no. Among the giants of the industry there is still some uncertainty and they cannot agree. To plug in a flock of coils or to switch them, that is the question!

So let's be different for once and disagree with both methods. The disadvantages of coil switching are legion but the more prominent faults are these. The switching method necessitates a layout to group components near the switch. This in turn defeats the shielding. We have heard so many times, that for maximum gain and selectivity per stage the stages should be effectively isolated, and they cannot be isolated if they all center round a wave-change switch six inches long.

Switch points become dirty and make an indifferent connection after six months' or one year's operation. They always work when they are new, and unfortunately that is when we do our selection of a receiver. The following year the designer has no time for your suppliant whimper. He is too busy selling the new model guaranteed to be free from all the defects of your model and only four and a half dollars dearer.

Switching also necessitates trimming and padding capacities, which at 28 Mc. rob you of half the life of your rig, i.e., its inductance. Bear in mind that the gain in a ten-meter receiver depends a lot on the inductance-to-capacity ratio. Remember too that even with small condensers, smaller than normal, the value of inductance still is pitifully small. Add to this the fact that five inches of wire to and from a coil switch halves the useful inductance and more than halves the effective shielding, and then it is a little difficult to get enthusiastic over coil switching.

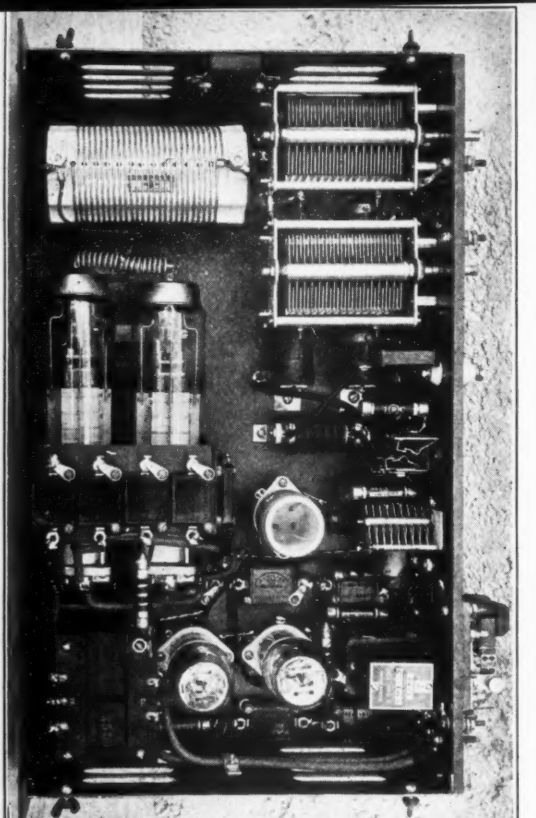
And yet, you say, these manufactured receivers seem to work fairly well. That's the rub. Fairly well is not good enough on 28 Mc. Have you ever tried putting a pair of phones in the output of one of these manufactured super's second detector? It is a revealing pastime devoutly to be recommended. Try it!

You can hide a lot of inefficiency and deficient design if you add a peppy audio stage to a super. But your phones should never require audio stages. The output of a '56 second detector can make a pair of phones rattle if the '56 is driven or excited hard enough, and if signals cannot be heard properly on it, it is not audio you need, but signal frequency and i.f. amplification, preferably signal frequency.

If the gain from the front end is not there, it means that it is being dissipated or lost, but audio amplification is not the way to make up

[*Continued on Page 78*]

*c/o Box 414, Hong Kong.



Interior view of the exciter unit described in the article.

Airline Transmitter . . .

ADAPTABLE FOR AMATEUR USE

By G. E. SMITH,* W4AEO[1]

For a number of years, the trend in amateur transmitter design has been away from the messy, inefficient bread-board layouts of old and toward the compact, self-enclosed and rack-mounted designs of commercial practice. Since commercial airline transmitters are more generally of a power rating consistent with the amateur's needs, the following description of a transmitter — a compact ground station unit of about 150 watts output on c.w. and 40 watts on phone—should be of general interest.

The following is a description of an exciter or medium-powered transmitter unit which the author had the opportunity of developing for ground station use by Eastern Air Lines. The result of this development was to be a flexible r.f. unit which could be operated as a self-contained transmitter on either phone or c.w. When used with the associated power supply and modulator, the unit has an output of 40 watts on phone, suppressor modulated, and 150 watts on c.w. One is also in operation as an exciter unit in a 1 to 3 kw. phone and c.w. transmitter. For this applicatino it is used to drive a pair of either HK354's or 450T's in push-pull; for phone this stage is modulated by a pair of HK354's in class B. In addition to the above requirements, it was necessary that the unit be capable of perfect keying at speeds normally used on a commercial circuit; it must be capable of break-in operatino, and it must be capable of working over a wide frequency range by merely changing crystal and coils.

Circuit Design

There is nothing original or tricky in the circuit used; it is straightforward in every respect. The crystal oscillator selected is not commonly used by amateurs, but it is used commercially, especially in the new Western Electric equipment. The circuit has a number of advantages over other types of crystal oscillators as far as frequency control and ease of adjustment are concerned. It does not, however, have a large power output.

The Crystal Oscillator

This oscillator, with crystal between control grid and plate, is commonly called the Pierce Circuit. If a coil-condenser tank is substituted in place of the crystal, it will be seen at once that it becomes similar to an ultra-audion or Colpitts oscillator.

This circuit was selected after all types of crystal oscillators had been tested, complete sets of readings had been tabulated, and the advantages and disadvantages of each taken into consideration. Each type of oscillator was keyed by various methods and the shape of the keying envelope was checked on the oscilloscope.

The only disadvantage of the Pierce oscillator is low output as compared with the more common oscillators, pentode, tri-tet, 6L6, etc. But a crystal oscillator should not be used for power output, as it has one primary function and that is to control the frequency of a transmitter. The r.f. crystal current should be kept low at all times to minimize frequency drift.

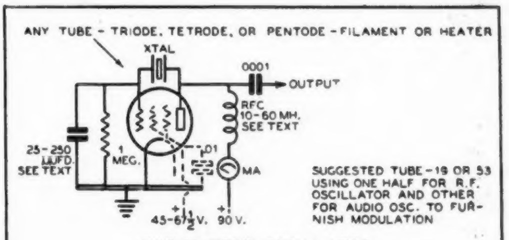
*Eastern Air Lines, Communications Dept., Miami, Florida.

[1]1406 Madrid Street, Coral Gables, Fla.

Why make the crystal do all the work, when, by the addition of another small inexpensive tube, the crystal can be run at low output and the burden shifted to the second tube? An ordinary receiving tube is much cheaper than a crystal. Through the use of the Pierce circuit no more tanks are required; in fact, one less tank is used in this circuit than is used in a tri-tet. The output from the two arrangements will be about the same. Another advantage of the Pierce is that the plate circuit is untuned and there are consequently no critical tuning adjustments which must be made correctly for proper keying.

This oscillator is by far the most active of any circuit that was tried. To prove this during the preliminary tests, some very poor grade of X-cut crystals that refused to oscillate in other circuits, including the tri-tet, all oscillated actively when put in the Pierce oscillator; it was even possible to key these heretofore inactive crystals at high speeds.

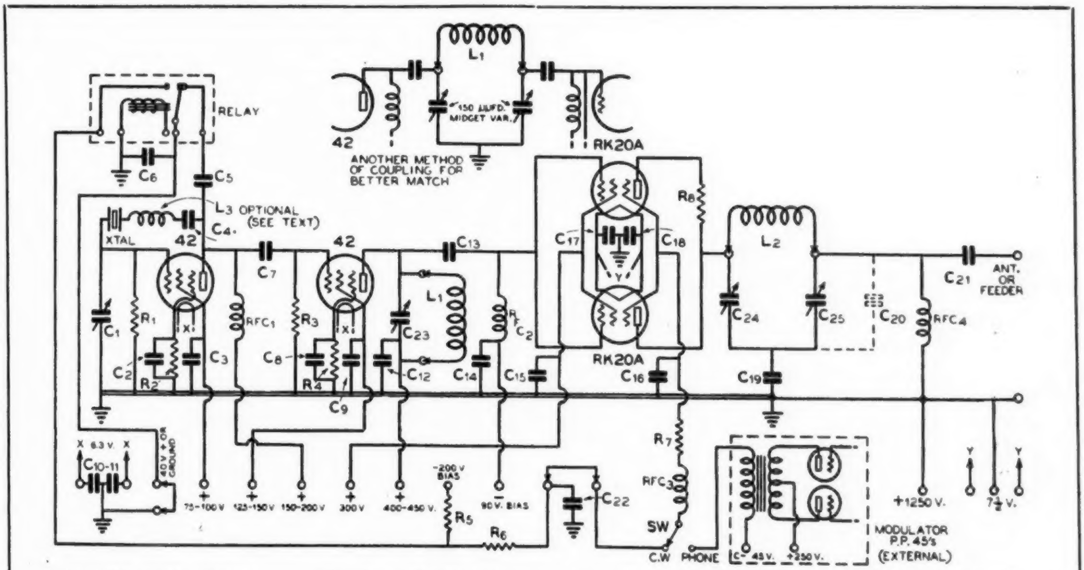
In addition to the complete circuit diagram of the transmitter, there is shown a schematic of the oscillator alone, which, by the way, makes an excellent test oscillator for the ham shack. Any crystal of any frequency can be plugged-in



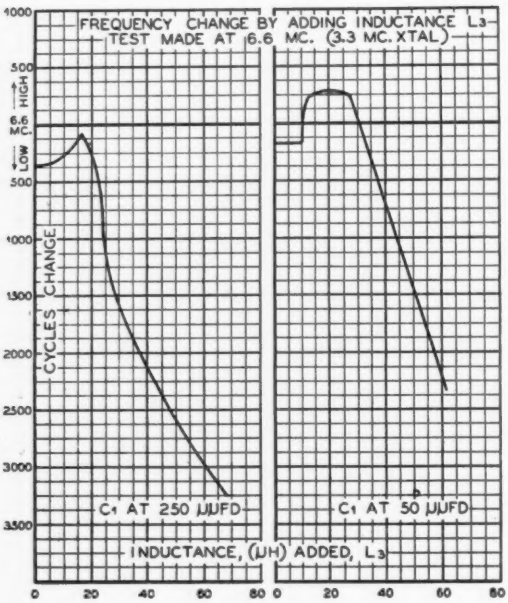
PIERCE TEST OSCILLATOR

and will immediately start oscillating with no tuning whatsoever. It is an especially handy gadget for aligning a single signal super as the crystal can be removed from the i.f. circuit and put into the test oscillator and the i.f.'s lined up on the nose for the exact crystal frequency used. In almost any other type of crystal oscillator except the Pierce, there is a certain amount of detuning introduced by the oscillator itself.

Some notes on the operation of the Pierce circuit will be presented. C_1 plays an important part in determining the grid excitation on the oscillator tube. For frequencies normally used by amateurs, a value in the vicinity of 150 μμfd. is correct. For lower frequencies, such as may be used in a test oscillator, 250 μμfd. should be used. The r.f. choke in the plate



C_1—250 μμfd. midget variable
C_2, C_3, C_4, C_5, C_6— .01 μfd. mica
C_7—.005 μfd. mica
C_8—.00025 μfd. mica
$C_9, C_{10}, C_{11}, C_{12}$ — .01 μfd. mica
C_{13}—.0001 μfd. mica
C_{14}, C_{15}—.01 μfd. mica
C_{16}—.001 μfd. mica
C_{17}, C_{18}—.01 μfd. mica
C_{19}—.01 μfd. mica, 2500 volt
C_{20}—.0005 to .005 μfd.
C_{21}—.01 μfd. mica, 2500 volt
C_{22}—0.1 μfd. paper, 600 volt
C_{23}—30 μμfd. midget variable
C_{24}, C_{25}—150 μμfd. variable, 3000 volt spacing
R_1—50,000 ohms, 2 watts
R_2—250 ohms, 1 watt
R_3—50,000 ohms, 2 w.
R_4—800 ohms, 2 watts
R_5—50,000 ohms, 3 w.
R_6—5000 ohms, 2 watts
R_7—50 ohms, 10 watts
R_8—5 ohms, 10 watts
$RFC_{1,2,3}$—2½ mh., 125 ma. chokes
RFC_4—2½ mh., 500 ma. choke



circuit of the oscillator should be about 2.5 mh. for amateur frequencies. For lower frequencies one from 10 to 60 mh. should be used. Of course, one of 10 mh. is all right for the higher frequencies, but is not necessary. In the unit shown, a National R-100 is used. Another important item is C_7. This must be at least .01 µfd. At first this does not look correct; in fact, on one of the first experimental models a conventional .0001 µfd. coupling condenser was used and the r.f. crystal current was found to be as high or higher than in a normal oscillator. The coupling condenser was then increased to .01 µfd. and the crystal current lowered to a normal value. The idea seems to be to couple tightly and thus to pull the current out of the crystal stage. *It is also important not to use over 200 volts on the plate of the oscillator and not over 100 volts on the screen grid, regardless of the tube used.*

It will be mentioned that during the preliminary tests various types of tubes were tried—41, 42, 6L6, 6L6G, 807, W.E. 307A, etc. All gave good results, but the 42 type was selected as it was short enough physically to be mounted in an upright position in the 5-inch chassis to be used. The 6L6 could have been used, but at the time the unit was developed this was a comparatively new tube and there was some doubt as to how it would stand up under r.f. use. The 6L6G could have been used, but the envelope was too large. The 42 also had been proved to have a long useful life in a similar unit that had been used previously.

Should this circuit be tried for amateur use, it is suggested that an octal socket be used which would allow the use of a 6F6G, 6V6G, or 6L6G without any circuit change. All have been tried with excellent results, especially the 6L6G.

The Buffer-Multiplier Stage

The second tube in the line-up of the completed unit is either a buffer or frequency multiplier. It will be noted that straight-through operation may be had without neutralization. This is due to the fact that the grid circuit is aperiodic or untuned. This tube also can act as a doubler or tripler with about the same ouput as is obtained when operating straight through. This is possible due to a slight amount of regeneration from the cathode resistor-condenser combination, R, C_8, which consists of an 800-ohm resistor and .00025 µfd. condenser.* This tube may also quadruple at reduced output. The resistor, therefore, serves a double purpose: that of furnishing regeneration and for supplying self-bias. This condenser could be made a 350 µµfd. variable whence the regeneration would be controllable over quite a wide range. The values given were selected after trying

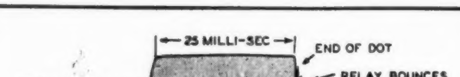


FIGURE 1. DOT AS TRACED FROM OSCILLOSCOPE SHOWING KEYING OF OSCILLATOR ONLY.

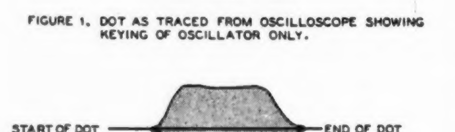


FIGURE 2. SAME DOT DURATION TRACED FROM OSCILLOSCOPE SHOWING DOT ACTUALLY EMITTED FROM RK20 STAGE - THE EFFECTIVENESS OF THE SHAPING CIRCUIT SHOWN.

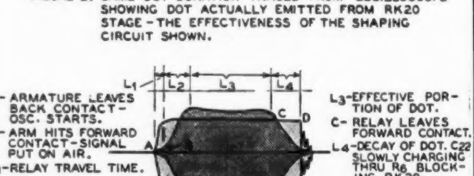


FIGURE 3. SAME DOT SHOWN IN OSCILLOSCOPE WITH OUTPUT FROM OSC.-BUFFER-DOUBLER & OUTPUT FROM RK20 STAGE SUPERIMPOSED OR MIXED TO SHOW RELAY TRAVEL TIME, SHAPING, ETC.

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*Note: It may be necessary to increase this condenser to .0005 µfd. when using the 6L6 tube due to excessive regeneration.

Eastern Air Lines ground station at Atlanta, Ga. The crystal-controlled receivers are located about one mile from the operating position as shown.

various combinations in quest of one that would give slight regeneration but still would allow the stage to be stable with no tendency to "take off" by itself. The tube selected for this position was also a 42. Should ten or twenty meter operation be contemplated, it is suggested that an 802, RK-25, 807 or RK-39 be used, as more output will be obtained on the higher frequencies.

The Paralleled RK-20A Final

The remainder of the circuit is straightforward but will be described briefly: The output from the buffer-doubler is capacitively coupled to the two RK-20A tubes which are in parallel. This method of coupling is rather inefficient as to impedance matching, but there was found to be more than sufficient drive on the frequencies used. Should higher frequency operation be desired, it would be better to couple by a matching network as shown, or by link-coupling using a separate tuned tank in the RK-20A grid-circuit.

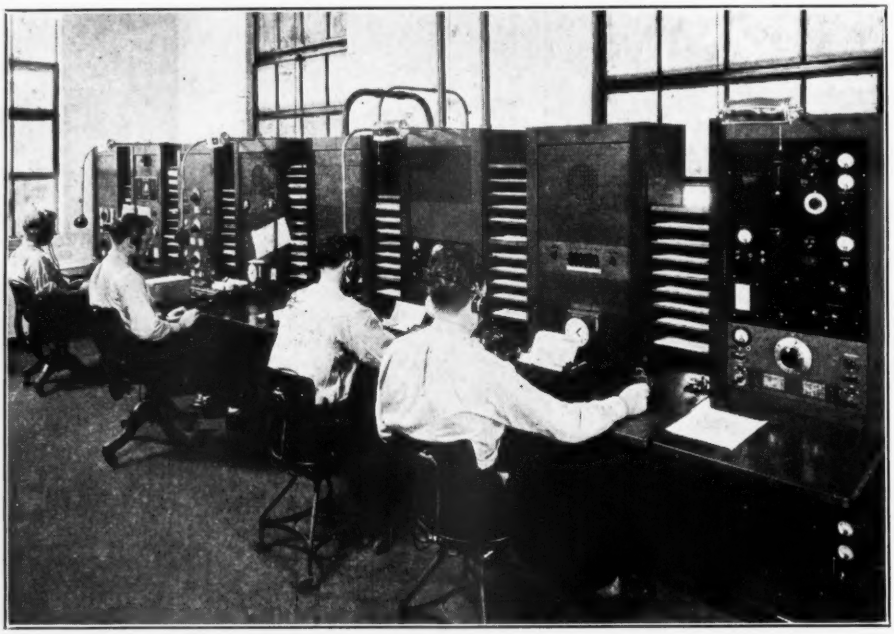
The plates of the RK-20A's work directly into a network tank circuit and through this arrangement any type of antenna, 500-ohm single-wire feeder, twisted pair, or concentric transmission line can be closely matched. It will be noted that the antenna matching condenser, C_{25}, is 150 μμfd. This was found to be sufficient capacity to match the average single-wire feeder or Marconi antenna except when the feed point is near a current loop. In such a case it will be necessary to parallel this condenser with a fixed one of the proper value. This additional condenser is shown by dotted lines. The fixed condenser also will be required to match certain low impedance transmission lines such as the twisted pair or coaxial type.

Practically any load condition may be matched by adjusting C_{25} and re-resonating C_{24}. C_{19} is used to protect the h.v. power supply in case of a flash-over on C_{24} or C_{25}. The 5-ohm resistor R_8 shown in the plate circuit of one of the RK-20A tubes is used as a "sing" suppressor as it is quite easy to develop a parasitic when using pentodes in parallel. This resistor is not shown in the photograph as the "anti-sing" choke shown was being used on some of the earlier units. The resistor was found to be superior; hence, it was incorporated in the later units.

Should phone work by suppressor modulation of the RK-20A not be desired, it is suggested that the newer RK-47 or 48 could be used to advantage in place of the RK-20A's. These could then be plate- or control-grid modulated. For lower outputs 802, RK-25, 807 or RK-39 tubes could be used, though it would be necessary to reduce the output from the buffer-doubler tube in order not to over-drive these tubes which require very little excitation. This drive can be reduced by lowering the plate and screen voltage on the buffer-doubler tube.

Frequency Shifting

C_1, the grid return condenser for the crystal oscillator, is also used for varying the frequency



E.A.L. ground station at Miami, Fla. Transmitters are remotely controlled. The unit to the extreme right in photograph is the frequency standard used for periodic checks upon the equipment.

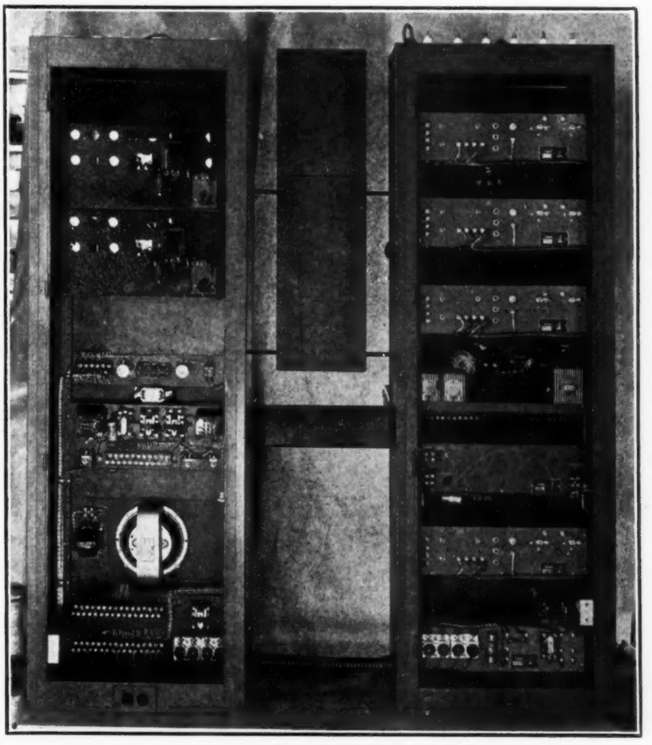
slightly, as is necessary in a commercial circuit to get all stations exactly on the same frequency. With a 4 Mc. crystal, C_1 will lower the frequency about 800 cycles when fully meshed. If a further reduction in frequency is desired, an inductance, L_3, may be inserted in series with the crystal; otherwise it should not be used. With certain crystals the frequency has been lowered as much as 5 kc. at the fundamental frequency, but it will be found that the circuit will not key well if the frequency is lowered this much. In fact, some crystals will become chirpy when keyed if the frequency is lowered only a few hundred cycles. This arrangement is recommended only for phone operation. Two graphs are presented showing frequency change vs. inductance added. Upon adding a small amount of inductance the frequency was raised slightly; but, as more was added, it was lowered. It was found necessary to add more and more capacity at C_1 as the inductance is raised. If too much inductance is added in the crystal circuit, the crystal will lose control and the oscillator will take off as an ultra-audion with L_3 as the inductance. It is suggested that not over a two or three kc. change be attempted on the fundamental, so that the circuit will remain stable. This arrangement, using a coil in series with the crystal, will not work successfully in either a tri-tet or pentode oscillator as very little frequency change will be had without the crystal losing control. If one of the old style variometers with a maximum inductance of about 50 mh. is available, it should prove useful in the Pierce circuit.

The Keying Circuit

The keying circuit will be described in detail and should be of special interest to the c.w. man. As mentioned before, one of the requirements of the unit was that it be capable of high speed keying with perfect break-in, even when working another station on the same channel. This is where most keyed crystal oscillators fail. Also, if the crystal is allowed to run and a following stage is keyed, break-in is impossible.

If the oscillator is keyed by the more common methods, such as center-tap, cathode, screen grid, etc., the oscillator will follow at slow speeds, but at higher speeds, signals become "chirpy" and the dots become light. All of the above methods were tried in various types of circuits and all failed in one way or other. The method decided upon uses a relay with a back contact. This is used to ground the plate of the oscillator (with respect to r.f.) through C_5 when the key is up. This requires that the relay be mounted as closely as possible to the oscillator since the Pierce circuit is such an active oscillator that it is actually difficult to stop it from oscillating!

This was proven in one of the first models which was bread-board built with the leads to the relay back contact about a foot long. With the key up, the oscillator continued to oscillate at reduced output. It is also necessary that C_5 be at least a .01 μfd. If a smaller value is used, the oscillator will not completely stop. As the relay armature leaves the back contact, the oscillator starts immediately with a very square build up. This is shown on the first sketch traced from the oscilloscope while keying at high speed with a motor-driven dot wheel. The "fuzzies" on the tail end of the dot are caused by relay bounce as the armature returns and hits the back contact. For this reason it is a good idea to use a relay with a light-weight armature to cut down on inertia as much as possible. A Kurman relay as shown in the photograph was selected due to the above reasons, and also due to its having a mycalex base which gives it good r.f. insulation. There is r.f. voltage on the back contact.



Rear view of four-channel 40-watt phone unit. Described in detail in article.

Because of this square front on the build-up and the immediate stopping of the oscillator when the relay returns, it was necessary to introduce some type of shaping circuit to round off or taper the build-up and the tails, thus reducing any tendency toward key clicks. This was accomplished by suppressor-grid keying of the RK-20A's, using the forward or make contact to "un-block" the suppressor grids of the RK's. The shaping is taken care of by the R_6-C_{22} combination. The values shown were found to be correct for high speed keying as they minimized the clicks sufficiently without the dots becoming too light. For amateur work where slower speeds are to be used, these values could be changed somewhat to give a slower build-up and longer tails.

The second tracing from the oscilloscope shows the signal actually emitted. The superimposed tracing shows the dot from the oscillator and from the p.a. The distance between the square front of the oscillator and the actual starting of the dot is the relay travel time. The forward contact also could be used for tube keying or control-grid blocking of the p.a., should this be desirable. Suppressor-grid keying was selected due to the small amount of current which must be broken by the relay.

The actual sequence of the relay is as follows: As the armature leaves the back contact, the oscillator immediately starts and is running at full output by the time the armature hits the forward contact. Upon closing this contact the 200 v. negative suppressor cut-off bias from the bias supply is grounded through the 50,000 ohm resistor, R_5. C_{22} discharges through R_6, reducing the negative bias on the suppressor grids to ground potential and the tubes pass current. As the armature leaves the forward contact, the reverse operation occurs and, as the armature hits the back contact, the oscillator becomes inoperative. The buffer-doubler tube keeps reflection from the p.a. stage out of the oscillator which is also a help in clean keying without "chirps." Sparking is practically nil at the relay contacts.

The type of relay used operates on 7 ma. current which helps reduce d.c. surge clicks. Low current relays are necessary for this service, as

these transmitters are often remoted several miles from the control location. Keying, instantaneous frequency selection of up to ten frequencies by the telephone dial and Strowger method, and press-to-talk, are all accomplished over a one-pair telephone line.

This method of keying is not original, the oscillator portion being used in the W.E. 14-B and 14-C 400-watt 10-channel transmitter. But, instead of using a number of relays to accomplish the keying, one relay in this system does everything. The suppressor grid keying method has been described before in a number of radio articles.

As is standard procedure for commercial telegraph transmitter adjustment, an oscilloscope is used for adjusting the keying of the transmitter. It is just as important in adjusting keying as it is to the phone man in adjusting modulation. Adjustments can be made much more accurately than with the human ear. An operator may be able to tell that the keying is not perfect, but it takes the oscilloscope to find what is wrong. Small transients, clicks, etc., that are often hard to detect by ear can be noticed immediately on the oscilloscope.

Tuning Up

The tuning of the circuit is very simple. It is only necessary to insert the proper crystal, either for straight-through or for doubling; to select the proper coil for L_1, and to adjust L_2. Turns should be shorted out by a jumper for operation on the higher frequencies. The coil shown covers from about 3 Mc. to 6.5 Mc. At the higher frequency about half the turns will be shorted. If higher frequencies are to be used, it is suggested that a more suitable coil be used or that the coil form shown be wound double-spaced; this will be about right for the 7 Mc. band. As there is no tuning of the oscillator, it is only necessary to tune C_{23}-L_1. This should be checked with an absorption wave meter because, as mentioned before, the harmonic output is practically the same as the fundamental and care must be exercised in order to select the proper harmonic. That is the reason C_{23} is only 30 μμfd. By using this value, it is impossible to get on the wrong harmonic, with the frequencies normally covered by this unit, when the proper coil has been inserted. The tuning of this tank and also of the final is conventional and will not be described.

Due to the method of keying and since the oscillator and the buffer-doubler tubes are self-biased, they continue to draw some current while the key is up. This may seem a disadvantage, but these tubes then act as an additional bleeder and improve the regulation of the 400- to 500-volt supply. The voltage to these tubes should be low enough so that the plate dissipation does not exceed the class "A" rating when the key is up. As the final is biased to cut-off by either batteries or a bias supply, it draws no current with the key up. Battery bias can be used on the buffer-doubler tube, if desired, by opening the ground return of R_3 and inserting about 30 or 40 volts of bias.

No data will be given on winding the coils; these will depend entirely on the individual line-up and on the bands to be used. This information can be obtained from any of the amateur handbooks.

It also will be noted that the RK-20A's are in a horizontal position, due to the limited space. It must be remembered that the filament must be in the vertical plane where these tubes are mounted flat.

Incidentally, it will be mentioned that these units have been used on a frequency as low as 278 kc. for aircraft work.

One of the local amateurs, W4SI, is using a similar unit as an exciter, the tube line-up being an 802 Pierce oscillator and 807 buffer-doubler into an RK-20, which drives a 50-T into a 300-T with 1 kw. input.

The Photographs

The photograph showing the interior will give some idea as to the compactness of the unit. It is mounted on a standard 5¼" relay rack panel and is housed in a 5"x10½"x17½" cabinet. The wiring is possibly not as neat as it could have been, had there been room for a sub-base, but this was not possible due to the limited space. 150 watts from a unit of this size was considered quite good. The large number of terminals are necessary to make the unit as flexible as possible for use as phone or c.w. internal or external voltage divider, etc. For phone use in the 40-watt stations, the relay is not necessary and is left off the unit. Press-to-talk is accomplished in the a.c. side of the h.v. power supply. This, incidentally, uses a bridge rectifier of three 5Z3 tubes to furnish the 1250 volts for the entire transmitter. The filaments of the RK-20's also are tied on with the press-to-talk relay and are only lit when the transmitter is on the air. This may seem like poor engineering, but much longer

[Continued on Page 81]

Amateur Operators and

THE NAVAL RESERVE

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Naval Communications Reserve activities can be an absorbing hobby as well as a provider of trained operators in case of national emergency.

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***By* LESTER HARLOW,* N5CVO-W5CVO**

Many amateurs have heard of the Naval Communication Reserve, either over the air or through the printed page, and have wondered what it is, what it does, what it offers, and how they may become affiliated with it if they are interested. Then, too, it is the thought of many that the membership is more or less restricted to those who are in or near large cities and who can attend the various unit meetings in person. This article is to call to the attention of many amateurs the purpose and nature of the Naval Communication Reserve, and how interested men may join.

The Naval Communication Reserve (hereafter referred to as the NCR) was organized in 1925 for the purpose of training men in the methods of naval procedure, so that in case of another national emergency, such as war, flood, etc., an adequately trained force will be available for duty, and much time will not be lost in training men.

The NCR is for sea-going operators as well as for those on land. Today a number of the shipping companies will not hire men for radio operators on their ships or at their land stations unless these men are members of the NCR.

To many, the organization of the NCR seems to be very intricate and complicated; yet, to those who have studied it and are familiar with it, it is very methodical and logical The United States is divided into districts with a district commandant, and directly under him a district commander. Each district in turn is subdivided into sections and units with a commanding officer over each.

In the larger cities where there is a federal building available, many units have complete quarters, and in many cases this includes a transmitter and receiver for contacting members of the various units and sections. Classes are given in code for the beginners and in naval procedure for the more advanced. By actually handling naval traffic, skill is developed and the reservist becomes more valuable to his country.

In the winter months the various districts compete to see which district will be first in the country. The district that wins this coveted honor is an all-around good district as the scoring is determined by a number of different factors.

In some cities near the coasts, week-end cruises are given to members of the various units. On these cruises the men do actual work, as they would if they were on the largest ship of the navy. Each year a number of men are given two weeks' training duty, either ashore or afloat, during which time members of the NCR have actual experience on board some naval vessel or at some naval shore station. During this training period, actual naval traffic is handled.

While the reservist is on this training duty, he is paid according to his rating and the number of days served. Also, his transportation to and from his home is paid. Many of these cruises are to other lands and the experiences had during the cruises are a pleasant source of recollection later. To many members the making of one cruise more than repays for the time and effort expended in four years of service. The number of men making these cruises each year is determined by the amount of appropriation from Congress, and the men who actually go are selected by their service to the NCR during the preceding year.

Weekly drills are held during the winter months. These drills are conducted so as to give the reservist training similar to that which he would receive on actual duty.

There are not many obligations to assume when a person enlists. After one passes the physical examination and is otherwise qualified to join the NCR, he agrees that during a definite period of time he will serve the U. S. Navy according to the rating held, whenever the conditions arise that necessitate calling upon

[*Continued on Page 76*]

*Siloam Springs, Arkansas.

Rialto Bridge Across the Grand Canal, Venice.

THROUGH

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By

REUBEN WOOD,* W6LFO

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If one were to inquire as to which of my traveling effects was most instrumental in providing me with social contacts and in leading to unplanned and interesting adventures during the two months my brother and I spent in Europe last summer, he might be surprised—indeed if he weren't a ham he might be baffled—at the answer. It was certainly not the tuxedo which I carefully packed, which many times I laboriously repacked, and which finally I again unpacked without once wearing it. Nor was it the white suit and white shoes whose usefulness scarcely surpassed that of the tux. Nor was it any of that group of letters from Great Aunt Sarah's brother-in-law to his good friend's cousin in Spain which often accompany the traveler (although such letters often serve rather effectively as excuses for making acquaintances which turn out to be quite pleasant). More potent than any of these things was the intangible possession, my ham status, and its tangible concomitant, the Callbook.

Having read the travel article in the July RADIO by W9FM and W9SLG and having talked to them about their Mexican trip, I was not unaware of the usefulness of an amateur call in traveling abroad, and I determined to capitalize on mine as fully as time and the proposed itinerary would permit. Just to start the ball rolling, before leaving New York I wrote letters to seven Paris hams, chosen largely at random, telling them of my proposed trip to France and of my desire to meet some of the OM's there.

The transatlantic voyage was without incident. The water was calm and the weather, except for being a little warm until we got out of the gulf stream, was quite comfortable. The first stop was Cobh, Ireland, where we anchored to land some passengers and to discharge cargo, chiefly American automobiles, onto a tender. Very early the next morning while it was still dark, I was awakened by the donkey engines again unloading the hatches, and I dressed and went on deck to catch a silhouette glimpse of Plymouth, the only sight of England I was to have for several weeks. The same day about noon we reached Cherbourg, France, where we disembarked and took the train for Paris.

F8MM Entertains Us

The following day I received a letter from Rene Chailboux, F8MM, cordially inviting me to look him up. Incidentally, 8MM was not one of those to whom I had written, but F8MX, who was, had passed his letter on to 8MM before leaving Paris on a vacation trip.

That evening Rene came for me in his Ford V8 and we took advantage of the summer evening for a pleasant twilight drive down the Champs d' Elyses and in the Bois du Bologne. It is seldom that one sees anyone in or near Paris driving at night with his headlights on. They depend almost entirely on the street lights, an aid to driving but not so good for the pedestrian. In fact, the pedestrian doesn't have a chance in trying to cross a Parisian boulevard unless the traffic has been stopped by a light or a cop. When it was dark, we went over to his station for a rag-chew interspersed with QSO's.

F8MM has three hobbies: travel, photography and radio. During his two visits to the U. S. in 1933 and 1934, he traveled a total of 11,000 miles in the country, almost all of which was by air. On his last visit to America he made the fatal decision to take back as a

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EUROPE

Call Book


The Eiffel Tower and Paris Exposition of 1937

souvenir an all-wave receiver. This set brought in the ham phones and it wasn't long before Rene had his own ticket. Although he's been on the air now for only about fifteen months, he lacks just Asia for a w.a.c. The present rig, built in conjunction with F8MX, is used chiefly for phone. The r.f. portion employs a 6L6, 807, and two parallel HF100's. Rene's English, which he taught himself by using phonograph records, is very good; in fact, several times he puzzled the French waiter at a cafe where we ate by inadvertently lapsing into English while ordering. He told me that his last visit to the U. S. had inspired him to improve his linguistic facility, but that the result of the all-wave receiver had been completely to side-track that ambition in favor of radio activities.

On my last night in Paris, 8MM took me to the Paris Exposition. It is built around the Eiffel Tower as was the fair in 1889 for which the tower was built. The lighting effects were beautiful and the colored fountains in the Seine were particularly effective. The exhibits themselves were not particularly impressive, a large number of them even then in July being as yet unfinished. The American Building itself was not yet open despite the fact that the fair was scheduled to begin in May. The cause of the delay is supposedly labor difficulties, including the new 40-hour French labor law.

A Call on F3CX

Some difficulty was encountered in finding F3CX (M. Eugene Allain). His home is in Rosny sous Bois, which is quite a bit out of Paris and involves a couple of bus transfers. In one instance, after futile attempts of the bus conductor to convey to me a relatively simple idea, a kind German lady translated his remarks into German and I managed to translate enough of hers into English to figure out that I was supposed to get off this bus and to transfer to another one of the same number going in the same direction (mine not to reason why; mine but to get to Rosny).

Finally arriving at the house I was undismayed by the sign "Mechant Chien" and, after knocking, was met by Mrs. Allain. Mr. Allain was not yet home but Mrs. Allain, who speaks little English, and I, whose French is negligible, managed to carry on something of a conversation with the help of a dictionary and Simone Allain who is now studying English in school. There was no difficulty after F3CX came home, because he had formerly been with the Paris branch of the National City Bank of New York and there, as well as through QSO's, had had good practice in English.

After tea we went to the shack. I was greatly impressed by the piles of QSL cards. Mr. Allain was a radio operator in the World War and has been in radio on and off ever since. He works with low power and uses c.w. almost exclusively. While looking over some of his German QSL cards, he remarked that a relatively large percentage of Germans know French and vice versa. He pointed out that this ability to talk to one another is handy in radio work as well as in other circumstances, such as when traveling or having a war with each other. Lately 3CX has been doing considerable experimenting on directive antennas and has had some

very satisfactory results. His experiments in this line have been based considerably on recent articles in RADIO to which both he and F8MM are subscribers.

I met F3HM, with whom I had exchanged 73 the night before from F8MM, in his radio store. He is Marcel Wallace, born in Roumania and an American citizen. He has his M.S. degree in chemistry and was for several years research chemist for the Allied Chemical and Dye Co. in the United States. Later, he became interested in the possibilities of electrolytic condensers and was probably the first to develop them practically. As early as 1924 he had employed them in an all-electric radio receiver which he manufactured commercially. Since that time he has drifted farther from chemistry and is, at present, the Parisian dealer for several American radio firms, which business takes him to the U. S. several times a year.

He admitted that it was quite exceptional for an alien to be assigned a French call but explained that the license application of a noncitizen could be granted if it were first approved by the Ministries of War and Navy and by the secret police. Since he has been in business in Paris for a number of years, his application received the necessary approvals.

Switzerland and HB9BG

France is a flat country. The train trips from Cherbourg to Paris and from Paris to Basel reveal many spots of pastoral beauty—green fields, yellowing grain, small truck gardens and the like—but little of mountain scenery. However, this lack in France enhanced, by contrast, the pleasure of our three-day stop in Lucerne, Switzerland. Here, surrounded by tall cloud-clad Alps, lies cool Lake Lucerne and on the edge of the lake is the neat Swiss city. It is partly old and partly new, a mixture of the quaint and modern, but, from the old covered wooden footbridges to the wide macadam pavement of Schweitzerhofquay, it is bright and clean. Its 50,000 citizens live by many trades, watch-making, woodcarving, and embroidery being the more prominent ones.

Rene Chailboux, F8MM, and his station.

The Author, Reuben Wood, W6LFO, in Potsdam. Looks to us like he is in the gutter but Reuben says that it must be two other people.

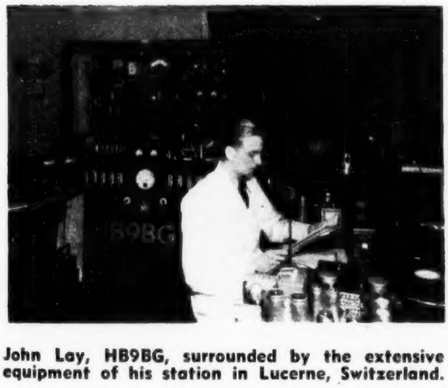
Careful perusal of the Callbook indicated that there was only one Lucerne ham. Failing to find him at his home address, I consulted the telephone book and with the aid of it and of a map of Lucerne I went to the radio store of Lay-Bryner and met John Lay, HB9BG. Here luck was with us again in that John spoke excellent English. As a matter of fact, I later found out that he was also fluent in French, German, Italian, Spanish, and his own Swiss dialect. His interests are wide. Besides his languages he has studied accounting, commerce, and radio. He would like to come to the U. S. to continue his studies but at present is needed in his father's store. However, HB9BG is only 19 so there's still plenty of time.

After a chat at the store, we went over to the shack which is the result of about three years of radio experience. Its equipment is extremely complete, probably more so than that of any other station I saw in Europe. Its drawback is that it is located in an apartment in the center of town and also relatively close to the mountainside. Because of the bad QRM and poor propagation conditions inherent in such a location, the w.a.c. certificate on the wall is quite a tribute to the OM. The final stage of the transmitter is normally an RK20; however,

Public bath in a Swiss river. The men swim on one side of a central fence, the women on the other. Spectators stand on a bridge and see both sides.

to increase power it is only necessary to throw a switch which feeds the output of the RK20 to the grid of a larger bottle. In Switzerland, as well as in France, the legal limit is 50 watts.

After looking over the rig, we drove over to the other side of Lucerne and somewhat up in the hills to look for a new station location. HB9BG is looking for an upstairs room in a house away from the city QRM and as high as possible, which the owners would be willing to rent for the station. If and when he finds it, he will have to rebuild the transmitter because, as it has grown up inside its present room, it has become too large to go through the door. We didn't find a satisfactory available location that afternoon and, in any case, it will probably be several months before the station can be moved



John Lay, HB9BG, surrounded by the extensive equipment of his station in Lucerne, Switzerland.

because 9BG is to leave shortly to serve his three months in the Swiss army. This is required of all young men in Switzerland.

The greatest thrill HB9BG gave me, strangely enough, had nothing to do with radio. On my last day in Switzerland he drove me in his '37 Ford to Zurich, a distance of about forty miles. The road was two-lane, winding, and covered with bicycles, and I must say that I became rather speed-conscious when we began hitting 120 kilometers per hour even though a kilometer is only about 3/5 of a mile! At the beginning of this orgy, the only words I could make out of the conversation between Lay and his two Swiss friends were "Chicago gangsters," from which I deduced that someone had been seeing too many American movies.

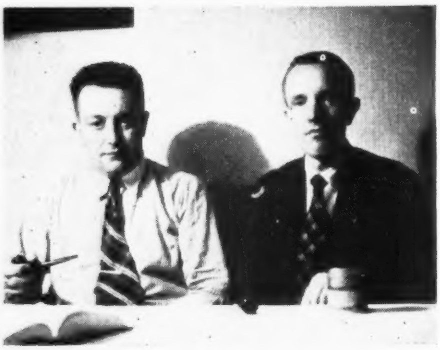
Over the Alps to Venice

The trip from Lucerne to Venice was a continuation of Alpine scenery. From the snow-capped peaks of St. Gothard Pass drop innumerable waterfalls; some, delicate gauzy sprays; others, narrow threadlike streams, and others, rushing torrents, but all dazzling white in the Alpine sunshine. Aside from their beauty, these falls are very valuable to Switzerland as sources of energy, especially so since coal is scarce there. For this reason, as well as because of the mountainous topography, most of the railroads in Switzerland are electric, a boon indeed to the traveler accustomed to sitting in the smoky third class coaches of steam trains.

The beauty of Venice is quite in contrast to that of Switzerland. It is the beauty of age and of the past. Actually the city is quite as one would imagine it. It has its gondolas, its Grand Canal, its Rialto Bridge, its St. Marks Square, all relics of an importance that is no more and all shrines to tremendous numbers of tourists. Its antiquity is emphasized by the fact that there is no new section of Venice. Modernization has occurred to a very slight extent because the only place new buildings can be erected is where old ones have been torn down.

It seems somewhat ironical that Italy, the native land of Marconi, should be the one important European country to withold amateur licenses. However, I understand that Italian amateurs are now being licensed.

Because I planned to be only two full days in Vienna I wrote, while still in Italy, to three Austrian hams. In reply I received one letter, not from Walter Schweitzer (OE1WS), but from his mother saying that he was at present away from Vienna but was expected back the next day, and inviting me over the following afternoon for tea. It turned out that Walter didn't get home when he had expected, but I had a pleasant chat with his mother.



Dr. Werner Slawyk, D4BUF, and Walter Schramm, as photographed by the author in Berlin.

Austria was the first country I encountered in which it is customary for vehicles to be driven on the left side of the road. Later I found that this usage also prevails in Sweden and in England. I had never realized how habitual it had become for me to look first to the left and then to the right in crossing the road, but this habit more than once jeopardized my well-being in Vienna where safety requires the exact opposite procedure.

Television in Deutschland

In Germany the two stops were Munich and Berlin. The very excellent Deutches Museum is in Munich. It is reputed to be the most complete science museum in the world and provides repletion for those who like to press buttons and see things work. An interesting sidetrip was to Oberammergau, the site of the famous Passion Play. It is a little village in the heart of the Bavarian Alps where one can see to best advantage the Alpine costumes worn by the villagers. The temptation was great to buy a green feathered hat, embroidered jacket, and a pair of leather shorts, but it was valiantly resisted in favor of another reel of color movie film.

In Berlin I met D4BUF, Dr. Werner Slawyk, and his friend Walter Schramm, who, though not at present on the air, is the technical advisor of the D.A.S.D. (German amateur association). We had a pleasant evening drinking tea, chatting, and receiving a television broadcast from the Berlin station. The quality of the television pictures was only fair but D4BUF, who is himself a television engineer for the Deutches Reichspost, explained that they are at present in the process of changing from the mechanical 120-line scanning system to the electrical 441-line system, a change that should greatly improve the quality of the transmissions. Television is already quite commercialized in Germany; in addition to the broadcasts, a regular television service in connection with long distance telephone calls between important points is offered.

D4BUF has not been to the U. S. and although he would enjoy making a return visit to the many W's who have signed his guest book, he may not have that opportunity for some time. The difficulty is caused by the German money regulations. In the attempt to prevent German and foreign currency from leaving the country, the regulation has been made that except for those traveling to certain countries, such as Austria, which have a reciprocal agreement with the Reich, the German traveler may take no more than ten marks or their equivalent in a foreign currency across the national border.

Seated, Mr. and Mrs. G6WY; standing, E. H. Swain, G2HG.

Consequently, although most Germans are technically free to travel where they like, they are effectively prevented from doing so by being limited to $4.00 for traveling money. As Dr. Slawyk pointed out, however, this is not a part of some diabolic scheme of the German government to harrass the German citizen who would go abroad, but is simply an expedient based on the assumption that the Fatherland has more urgent money requirements than those of its nationals for foreign travel.

Blondes in Copenhagen

Crossing the street in Copenhagen is beset by two hazards, the bicycles and the blondes. Both are present in large numbers and constitute delicate problems for a wandering American ham.

A surprise was the behavior of my Schick shaver when plugged into the Copenhagen line. The erratic performance was fairly well explained, however, when later I discovered that the house line voltage is 220. Copenhagen's electricity comes by underwater cable from Sweden's hydro-electric plants. Denmark itself is a flat country, very suitable for its farming and dairy industries, but devoid of energy resources either as waterpower or coal.

Past and present presidents of the Danish National Amateur Society (E.D.R.), OZ2Q and OZ1D, in 2Q's shack.

The two Danish amateurs I met, OZ1D and OZ2Q, are respectively the present and past presidents of the Danish amateur league. Both are bachelors. In fact, so many of the European hams I met were bachelors of an eligible age that I wondered if there was any connection between radio as a hobby and celibacy as a state of existence. The marital statistics of the radio brotherhood might be revealing. OZ2Q is interested in amateur photography as are almost all the OM's I QSO'd on the trip. Indeed, a photographic side interest seems an almost universal adjunct to amateur radio activity in Europe.

Soldiers are everywhere in Berlin; some blow their own horns.

London and the R.S.G.B. Convention

From Copenhagen we went to Stockholm, thence to Oslo, and finally to England. In London I looked up G2HG who is the head of the 56 Mc. experimental group and G6WY who is the Research and Experimental Sections Manager for the R.S.G.B. G6WY is one of the few British amateurs to have the high-power license which gives him a legal quarter kilowatt. Most licenses are for much lower powers such as 25 or 50 watts, but all these licenses have a considerable modulus of elasticity.

Certain aspects of the trip thus far had tended to convince me that I was not particularly lucky. I had been a week in Copenhagen without seeing the King of Denmark despite the fact that he had been frequently seen on the streets by others. King Carol of Roumania had been vacationing in Lucerne exactly when I was, but so far as I know he never laid eyes on me. Venice had for three days been simultaneously host to the Duke and Duchess of Windsor and to me, but we had effectively avoided each other; even when Reichsfuhrer Hitler visited the Art Exhibition in Munich at the same time I was in the building, I didn't see him! However, the tables turned when I was in London and I met two pieces of very good fortune.

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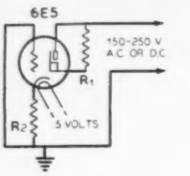

For guys that like to put PRETTY THINGS ON THE PANEL

One of the magic-eye indicator tubes, 6E5, 6G5, etc., will make a very pretty little front-of-the-panel time delay indicator. The hookup of the arrangement is shown in the accompanying circuit diagram. Very simple, isn't it? Nothing but the tube and two ½-watt resistors are required in addition to the regular plate and filament supplies in the rig.

R_1 can be anything from ½ meg. to 2 or 3 megohms, R_2, from 500 to 3000 ohms, and the plate supply voltage anything from about 150 to 250 or 300 volts, a.c. or d.c. The filament supply voltage can be varied depending upon the time delay indication desired. 5 volts, as shown in the diagram, will give a delay of about 30 seconds, just about right for the delay between application of the filament and plate voltages to mercury-vapor rectifier tubes. If a longer delay is desired, the voltage can be lowered; conversely, raising the filament voltage to the rated value of 6.3 volts will give a delay between the application of the filament voltage and the glowing of the eye of about 15 seconds.

The filament supply may be taken from any source of approximately the proper voltage that is at, or very near to, ground potential. In other words, the voltage may be taken from any filament supply in the transmitter of appropriate voltage except a rectifier winding, which is, of course, at a high potential with respect to ground. If the voltage is a little too high, say 6.3 or 7.5 volts, a dropping resistor may be used to reduce it to the proper value. The 6E5 heater draws 0.3 amperes.

The plate voltage may be taken from any plate supply within the voltage range specified, or it may be taken from the a.c. secondary of any low voltage plate transformer. The unit is self-rectifying; consequently, it will work as well on a.c. as on d.c.

The installation is simple; complete "magic eye" assemblies, tube, hood for the front, and mounting brackets, may be obtained quite inexpensively. One can be mounted upon the panel of the rig with a sign under it, "Close filament switch first; do not close plate switch until eye glows green."

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Amateurs and Early Broadcasting

Some credit to the amateur for the development of broadcasting at an early date in this country was recently given by Lloyd Espenschied in his article on "The Origin and Development of Radiotelephony" in the *Proceedings* of the Institute of Radio Engineers for September, 1937.

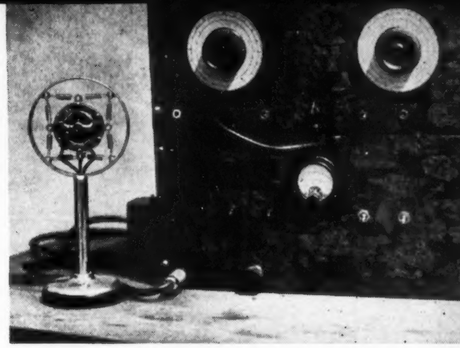
"By 1920-21 the stage was set in the United States for radio broadcasting. A radiotelephone technique was becoming available in the relatively empty portion of the frequency range centering about one megacycle. Something of an audience existed in the thousands of amateur radiotelegraphists spread throughout the country, a lively public interest in radiotelephony had been aroused during the war, and all that was needed to excite the public generally into providing itself with receiving apparatus was to have the experience of hearing speech and music on the air. These essential elements of an appropriate technique and of a widespread audience were lacking in the earlier years when De Forest and others broadcast speech and music upon a number of occasions with considerable success.

"Public interest was first fanned by amateur listening to the experimental telephone transmission being conducted by various people, amateur and professional. Engineers, in making tests, frequently availed themselves of reports written in by listeners, as a means of checking in a general way the effectiveness of their transmitters. For example, in the fall of 1919, tests made between New York and Cliffwood, New Jersey, of a pair of 500-watt transmitters intended for shipment to China, were reported by many amateur listeners. Tests of ship-to-shore radiotelephony, which were being made on more or less regular schedules from Deal Beach, New Jersey, were listened to and reported by hundreds of amateurs throughout the eastern part of the country. In the vicinity of Los Angeles, California, listening to the radiotelephone link to Catalina Island was becoming enough of an indoor sport to be embarrassing to the public telephone service."

An All-Year

PORTABLE

***By* KENNETH KIME,* W6KSX**



Front-panel view of the portable

Portable transmitters of all varieties have been brought to our attention for the last few months with more stress laid on vacation enjoyment than all-year-round usefulness. It has been my belief for a long time that the portable, low-power transmitter has its place in every ham shack and should be used on more occasions than just the summer months out-of-doors and at vacation time.

The portable transmitter described in the following paragraphs has been used for experimental purposes, dx hunting, cross-town QSO's, emergency flood relief work, field day contests—in fact, for more activities than the larger rig here is capable of.

It is more convenient to try out new circuits, tubes, and new ideas on a small transmitter and leave the main rig on the air—especially if you want to turn it upside down to operate on its innards.

For dx on either phone or c.w. on 10 meters, it works exceptionally well, pushing through to the Middle West and East with eight watts input on phone and 15 watts on c.w. Why reduce power on the big rig for cross-town QSO's when it is much simpler to start up the portable? You get just as good reports and much less trouble is encountered with b.c.l.'s.

Last winter when sections of Venice, Calif., were flooded, this rig was on the air from 2 o'clock Sunday morning until 8 o'clock Sunday night, handling flood traffic for the Red Cross and life guards, and coordinating instructions to the boats on 5 meters and to relief headquarters in Los Angeles on 160 meters. In the July A.R.R.L. field day contest, the rig was on the air for the full 27 hours, operating portable from Topango Canyon. All four call areas west of the Mississippi were worked. In the August low-power contest, all districts except the first, second and third were worked on 40 meter c.w. with 20 watts input to the 802, and again the rig was on the air another 27 hours without a pause.

* 2305 Oakwood Ave., Venice, Calif.

Sometime last fall I received an 802 and decided to build a rig around it. No, I didn't look in the junk box and find all the parts necessary—I have never believed in fairy wands and their magical powers or that any ham can build a first-class rig out of a junk box, at least, not those junk boxes I have looked into.

Construction

The rack and chassis are homemade, being designed after a commercial type that was too small for this job. I purchased six feet of half-inch cold-rolled angle iron, four feet of half-inch strap iron and about six square feet of 18-gauge galvanized iron. The angle iron was bent in the form of a square "U" with the legs bent up at right angles for part of their length as shown in the layout diagram. The strap iron was laid diagonally across the bottom, cut for length, and bolted to each side member.

The front panels are cut 9 inches by 17 inches; one-half inch top and bottom is bent back to make the panel more rigid and also to give a nicer joint between the top and bottom panels. A cut nine-sixteenths of an inch long is made in each end of this half-inch turned-back section to permit the panel to fit flush against the upright angle section. As the panels are sufficiently rigid, there is no other bracing across the front of the rack. Also, it is never necessary to remove the lower unit because it may be worked on from the bottom.

The chassis pans are cut 15¾ inches by 12½ inches with two inches turned down on one side and one-half inch on the other. The end sections are cut on a triangle with a half-inch turn-back to fasten to the chassis pan and to the front panel. Don't forget to cut two *right-hand* and two *left-hand* sections.

The socket holes for the crystal, coils, and tubes are laid out and cut, as are the socket holes for the power cable, on the rear of the chassis. One-inch holes are cut to mount the tuning condensers under the chassis. Then, the chassis and panel assemblies are set up and

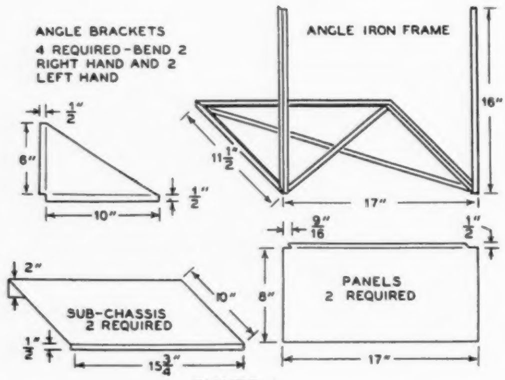


FIGURE 1.

mounted on the rack. The front panels now are laid out for drilling. When the panels have been drilled, they are given a good cleaning and a coat of crystalizing lacquer. Then, reassemble the chassis and panels and mount the sockets, transformers, switches, etcetera. The wiring then may be done in any manner that is convenient.

The Panel Layouts

Referring to the illustrations before going into detail about the circuit, the front panel is conveniently laid out as shown on page 47. The antenna lead is connected to the through insulator in the upper left-hand corner. The left-hand dial is the coupling condenser control and the right-hand dial is the plate tank condenser control. The meter is shown plugged into the oscillator-doubler cathode jack; the next jack is in the push-push doubler cathode lead. The small knob is the band-change and excitation-change switch; the jack just to the right of that is for final plate current. The jack on the right is in the final grid lead. On the lower panel, the left-hand toggle switch is the s.p.d.t. switch which throws the 225 volts on the modulator tube or to the receiver power socket. The next is another s.p.d.t. switch which puts $-27\frac{1}{2}$ volts on the suppressor grid for phone or $+37\frac{1}{2}$ volts on the suppressor grid for c.w. The next is a s.p.s.t. switch for the 110-volt a.c power supply; the right-hand switch is an s.p.s.t. switch for high voltage on and off. The mike plugs into the lower left-hand jack, and the gain control is just to the right of it.

In figure 2, we have a rear corner view which shows the layout of the power supplies and modulator on the lower shelf, and the power cable and extra power sockets on the rear edge of the chassis. The power socket at the far left is to bring the high voltage supply out for any other experimental set-up or checks. The socket on the right is for supplying a receiver. The single lead just to the right of the power cable is the positive high voltage line to the final amplifier. High level modulation on the plate and screen of the 802 can be employed by breaking this lead and inserting the secondary of the modulation transformer. The 53 class B modulator from the 5-meter rig came into its own here and really did a fine job.

The modulator power supply is in the forefront with the modulator tube showing up in the shield can just behind it and the main power supply back in the shadows. The filament battery shown was a little too large to be incorporated in the rig; however, for portable work, there are several corners where a couple of flashlight cells may be stored.

Figure 3 is of the top unit of the rig comprising the r.f. section. Looking from right to left on the rear of the chassis, we have the oscillator plate coil, its tuning control in front of the 6A6, the doubler section plate coil and its tuning control in front of it. Link-coupled to it is the push-push doubler grid coil with its tuning control in front of it, then the second 6A6, and, last, the push-push doubler plate coil. At the left-hand side to the front, we have the 802 final with its plate tank condenser on the panel; just back of it is the plate blocking condenser and r.f. choke.

In the center is the tapped plate tank coil mounted directly over the band change switch which is under the chassis. This coil is wound on a five-prong giant Bud form and is set up from the chassis about one-half inch. It works satisfactorily on four bands, but the efficiency is

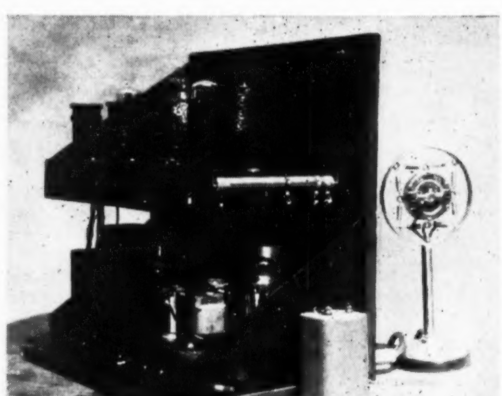


Figure 2. The complete rig, rear view.

questionable for the last two high frequency bands. Consequently, I wound separate coils for 20, 10 and 5 meters, as well as for 160. However, when operating away from the home station, the one large tapped coil is all that it is necessary to take along. The large condenser in the front right-hand corner is the antenna coupling condenser.

Electrical Design

Turning the r.f. section over, we find in figure 4 the first item of interest: the mounting of the tuning condensers. Bakelite strips were cut to cover the one-inch holes in the chassis. Then, they were set up from it about one-fourth inch and the condensers mounted in holes through the centers of the strips. This allows extremely short leads from the condensers to their respective coils, even though the exciter must be tuned from behind the panel. The main power supply bleeder is on the left-hand edge of the chassis, which makes it accessible from the end of the complete unit when assembled.

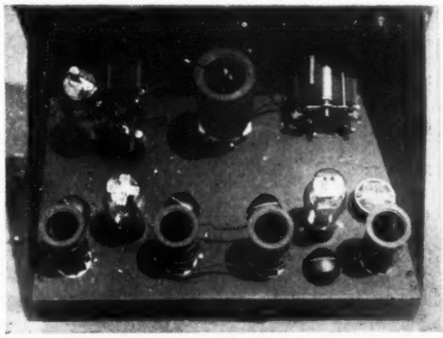
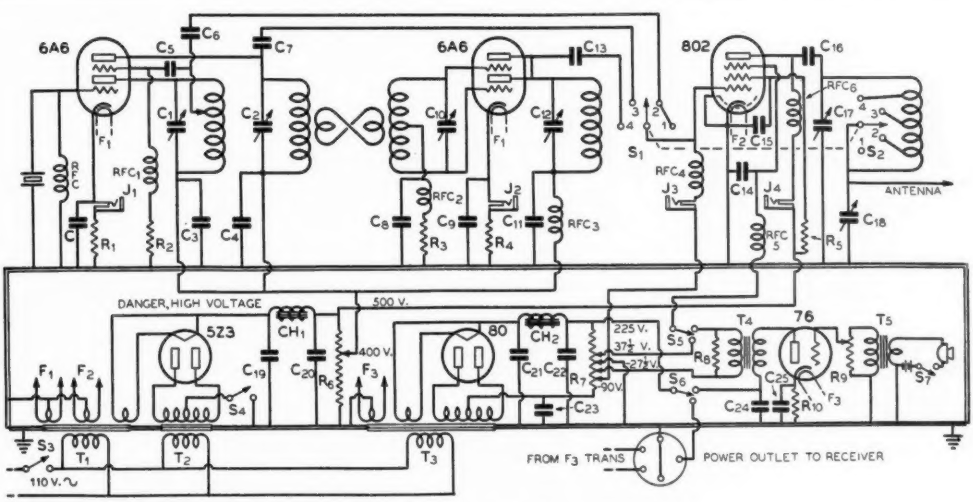


Figure 3. Top unit of the rig comprising the r.f. section.

The front section of the band-change switch shorts out turns on the final plate tank and the



Schematic of the All-Year Portable

- C—.01 µfd. 400 volts
- C_1—140 µµfd. midget variable
- C_2—100 µµfd. midget variable
- C_3,C_4—.01 µfd. 400 volts
- C_5,C_6,C_7—.001 µfd., 400 volts
- C_8,C_9—.01 µfd., 400 volts
- C_{10}—100 µµfd. midget variable
- C_{11}—.01 µfd., 400 volts
- C_{12}—35 µµfd. midget variable
- C_{13}—.0002 µfd. mica
- C_{14}—.001 µfd., 400 volts
- C_{15}—.01 µfd., 600 volts
- C_{16}—.00025 µfd. mica
- C_{17}—100 µµfd. midget variable
- C_{18}—350 µµfd. midget variable
- C_{19},C_{20}—8 µfd., 500 volt elect.
- C_{21},C_{22},C_{23}—8 µfd., 450 volt elect.
- C_{24}—0.5 µfd., 400 volts
- C_{25}—1.0 µfd., 400 volts
- R_1—500 ohms, 10 watts
- R_2—50,000 ohms, 3 watts
- R_3—100,000 ohms, 3 watts
- R_4—300 ohms, 10 watts
- R_5—20,000 ohms, 10 watts
- R_6—25,000 ohm 25 watt bleeder
- R_7—25,000 ohm 25 watt bleeder
- R_8—100,000 ohms, 1 watt
- R_9—500 000 ohm potentiometer
- R_{10}—2500 ohms, 1 watt
- R. F. Chokes—125 ma., 2½ mh.
- T_1—Fil. trans., 5 volts at 3 amps., 2—6.3 volts at 2 amps.
- T_2—Power trans., 1000 c.t. at 250 ma.
- T_3—BCL power trans., 700 c.t.
- T_4—1 to 1 interstage audio trans.
- T_5—Midget microphone transformer
- S_1,S_2—Band-change switch
- S_3—Main line switch
- S_4—H.v. power supply switch
- S_5—Phone-c.w. switch
- S_6—Rcvr.-speech stage switch
- S_7—Mike current

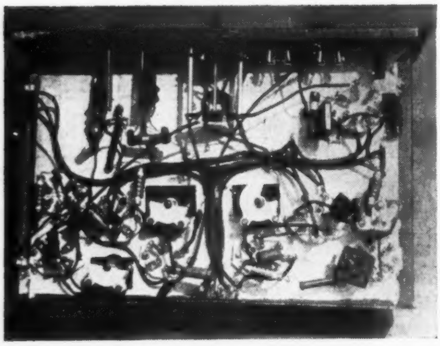


Figure 4. Bottom of r.f. section.

rear section selects the excitation from the proper excitation tank. The rest of the layout is more or less conventional. Parallel feed is used to the final plate and simplified Collins antenna coupler. It is possible to load the final amplifier to practically any piece of wire within reason, but don't expect exceptional results. Nothing will work as well as an antenna cut to the frequency of operation. However, for emergency setups and restricted space, this coupling device is hard to equal.

Tuning Up

The negative bias for the grids of the 802 is taken from the speech power supply. This has proven more satisfactory than using batteries, from a portable standpoint, and the operation is the same once it is adjusted properly. This type of bias also permits crystal keying, eliminating key clicks, and making possible break-in operation. A 25,000-ohm, 100-watt bleeder is used for the bias voltage divider. Remember that the bias adjustments should be made with the final loaded for normal output. The negative voltage for the suppressor grid is taken off this same resistor; consequently, the two voltages must be adjusted at the same time. It takes a little juggling and checking to get it set. Also watch the grid current to the 802, keeping it close to five ma. After the tank coils have been wound for the desired bands, it is a good idea to run through the whole group and check the bias to both grids again. There will probably be no change if the grid current to the 802 is kept at the same amount on all frequencies.

When tuning up for the first time, insert an open circuit plug or short piece of wooden dowel rod in the plate circuit jack of the 802 and in the cathode jack of the push-push 6A6, then drop the plate voltage to the 6A6 oscillator to about 350 volts. With the full plate voltage on the oscillator, 400 volts, it has a tendency to be erratic in operation until the coils are trimmed to the optimum L/C ratio and both sections are tuned to resonance. When crystal keying is used, it is best to drop the plate voltage somewhat, because at high plate voltage the crystal has a tendency not to break into oscillation every time the key is closed.

[*Continued on Page 84*]

COIL CHART

Band	Oscillator		First Doubler	Second Doubler		Final Tank	
	Total	Tap		Grid	Plate	2½" Dia.	1½" Dia.
160	50	25					50
80	28	15				30	
75 (160 xtl)	50	25	30			30	
40	12½	8				15	
20 (40 xtl)	12½	8	8½			5	8
10 (40 xtl)	12½	8	8½	8½	3½	2	3½

Coil Notes

160-meter coils (both osc. and final) wound with no. 24 enam. All other oscillator and doubler coils wound with no. 20 enam. All final tank coils (except 160) wound with no. 14 enam. Final coils shown as wound on 2½" dia. form are not individual coils; this is one tapped coil of 30 total turns, the numbers indicate where the coil is to be tapped for the various bands. The 1½" dia. coils are individual coils for each band, wound on Hammarlund forms and spaced to 1½" total winding length. "Tap" on oscillator coil indicates number of turns from ground end to excitation tap as shown on schematic drawing.

IMPEDANCE MEASUREMENTS

. . . *With a Matching Stub*

By* ROBERT M. WHITMER

The measurement of the terminal impedance of an antenna or of a beam array always has been somewhat of a closed subject as far as the amateur was concerned. The amount of expensive measuring equipment previously required has been prohibitive. Recently Mr. Whitmer has evolved and simplified a method whereby such measurements may be made with nothing more expensive than a ¼-wave matching stub—about as inexpensive a piece of equipment as it is possible to find.

The mathematics in the first part of the article may seem prohibitive to some; do not be dismayed, they are there merely to prove the validity of this greatly simplified method of making r.f. impedance measurements. No mathematics are required in the making of an actual measurement; all calculations have been made and set down in chart form so that it is only necessary to refer to the chart to find the value of impedance.

Many amateurs are using shorted quarter-wave line segments for impedance matching between antennas and transmission lines. At least one paper[1] has told us how, experimentally these "stubs", as we shall call them for brevity, are adjusted for maximum power into the antenna with no standing waves on the transmission line. A curiosity as to just what goes on in the system has led to some interesting results. Our starting point is the general expression for the input impedance of a section of line[2] of *electrical length* ml degrees ($m = 360/\lambda$, $l =$ actual length), terminated by an impedance Z_t. [See figure 1 (a)]. This is

$$Z = Z_0 \frac{Z_t \cos ml + iZ_0 \sin ml}{Z_0 \cos ml + iZ_t \sin ml}, \quad (1)$$

where Z_0 is the characteristic impedance of the stub.

There are several familiar results which may be derived directly from (1). If for instance $ml = 0$ (no line at all), we obviously must have $Z = Z_t$, and (1) bears us out. If again

$$l = \frac{\lambda}{4},\ ml = 90^\circ, \text{ then } \sin ml = 1 \text{ and}$$

$\cos ml = 0$. For this case (1) becomes $Z = Z^2_0/Z_t$, the well-known "Q-bar" formula. Another interesting special case occurs when

$$l = \frac{\lambda}{2},\ ml = 180^\circ. \text{ Here } \sin ml = 0,$$

$\cos ml = -1$ and $Z = Z_t$, just as if no line were present. This tells us that for our matching stub we may use a length of either $\lambda/4$ or $3\lambda/4$ since the additional half wavelength has no effect.

In the matching stub of figure 1 (b) we have, looking from the transmission line, two line sections in parallel. One, x, is terminated in a short circuit; the other, y, by the antenna. Our terminating impedance Z_t is now the input impedance of the antenna itself. To find the impedance into which the line looks, we compute the admittance $Y = 1/Z$ for each of the two sections, add them and turn the sum upside down. It will simplify things if we call the difference between the stub length and a quarter-wave, d. Then $x + y = (\lambda/4) + d$, consequently $mx + my = (360/\lambda) \times \lambda/4 + md = 90^\circ + md$. The resulting net input impedance is

$$Z = \frac{1}{Y_x + Y_y} = \quad (2)$$

$$Z_0 \frac{Z_t \sin(mx - md) + iZ_0 \cos(mx - md) \sin my}{Z_0 \cos md + iZ_t \sin md}$$

Suppose now we make the stub exactly a

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[1] J. N. A. Hawkins, The J Antenna, RADIO, P. 40, April, 1937.

[2] This equation is derived from the fundamental definition of transmission line impedance.

$$Z = Z_o \frac{Z_t \cosh \Theta + Z_o \sinh \Theta}{Z_o \cosh \Theta + Z_t \sinh \Theta}$$

where $\Theta = \sqrt{(R + i\omega L)(G + i\omega C)}\ l$.

G, the conductance of the line, generally is neglected in any work; and R, the resistance of the line, can be neglected for the short lines normally used in r.f. transmission. With the elimination of these two negligible quantities, the equation simplifies to the one given in (1). For a derivation of this equation, see appendix of article by Morton E. Moore and F. L. Johnson, which appears elsewhere in this issue.

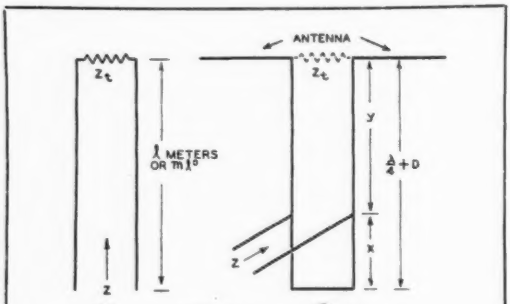


FIGURE 1.

quarter-wave long (md = 0). The input impedance to the stub is

$$Z = Z_t \sin^2 mx + i \frac{Z_0}{2} \sin 2mx. \qquad (3)$$

We can never obtain a perfect match here unless we happen to satisfy the conditions

$$R = \frac{Z}{\sin^2 mx}$$

$$\text{and } X = -\frac{Z_0}{2} \frac{\sin 2mx}{\sin^2 mx},$$

$$\text{where } Z_t = R + iX,$$

and R and X are the resistance (mostly radiation, we hope) and reactance of the antenna. To put it in another fashion, unless we just happen to have a particular R and a particular X, Z will always be partly reactive and we will never be able to get the transmission line entirely free of standing waves. Hence, this is not a useful length.

Someone may notice here that if we take the load off the end (open circuit), Z becomes infinite for all values of mx. Remember that we have neglected all losses in our stub. It behaves for this case just like a parallel-tuned circuit with no losses behaves—on paper, which is the only place that either a loss-less line or a loss-less circuit exists. This should not be too upsetting because when we do hang on a load, its losses are so much greater than those of the line that the latter are negligible.

Going back to (2) we may solve for Z_t. Then, if we are certain that Z has no reactive component—of which we can be assured when there are no standing waves on the transmission line — we can separate Z_t into its two components. When the characteristic impedance of the transmission line is the same as that of the matching stub, which is very likely to be the case at an amateur station, these finally boil down to (3)

$$R = Z \frac{\sin^2 mx}{\sin^2 md + \sin^2 mx \sin^2(mx - md)},$$

$$X = \frac{\sin md \cos md - \sin^2 mx - \sin(mx - md)\cos(mx - md)}{\sin^2 md + \sin^2 mx \sin^2(mx - md)} \qquad (4)$$

We now have a means of calculating both components of the antenna impedance.

Checking for Antenna Reactance

In particular, we have a means of measuring the reactance and determining when it becomes zero. In figure 2 we have a curve of md against mx for X = 0. To use this, we adjust the matching stub for maximum power in the antenna and no standing waves on the transmission line. We measure x and d, compute mx and md in degrees[3] and locate the corresponding point on figure 2. If it falls above the curve, the antenna has a positive or inductive reactance. If the point is on the curve, the reactance is zero, and if it is below, the reactance is negative or capacitive.

The vertical part of the curve at mx = 90° is not a mistake, even though it may look like one. Here the part of the stub between the transmission line and the short is just a quarter-wave long and hence has no effect, since it presents an infinite impedance across the line. The other part of the stub, towards the antenna, simply forms a continuation of the line which is now terminated in its characteristic impedance R = Z (See figure 3) and may be of any length. Any changes in md show up here, since mx is fixed at 90°.

Figure 3 shows $\frac{R}{Z}$ against mx *when the reactance is zero.* The values of md used in plotting this curve were taken from the curve

[3]The "electrical length" of a line or of an antenna is its length expressed in degrees, with a full wavelength equal to 360°. This is very convenient because when we have standing waves the standing wave pattern repeats itself every wavelength or 360°. If the actual length be l, the electrical length is ml = 360 l/λ, when l and λ are measured in the same units of length. Thus if l = λ/4, ml = 90°. If l = λ/2, ml = 180° etc. Since most of us make our direct measurements in feet, we may express ml as

$$ml = .3658 \, fl$$

where f is the station frequency in megacycles and l is the line or antenna length in feet.

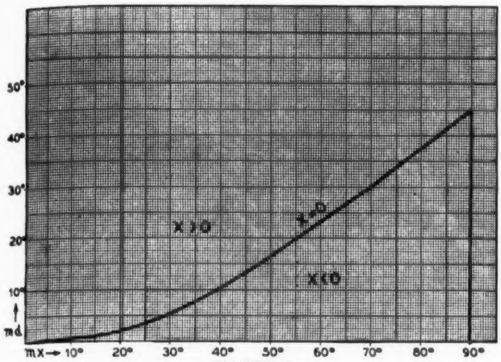


FIGURE 2.

of figure 2 and this will *not* give the true value of $\frac{R}{Z}$ for any other condition.

This knowledge is necessary in coupling an antenna with "Q-bars" of quarter-wave length since here our load must be a pure resistance. It may also tell us whether it is practical to use the Q-bars. As measured by this method, W8JK's two-section "Flat Top Beam"[4] one wave-length long would, when cut for X = 0, have a resistance of around 20,000 ohms. To match this to a 600-ohm transmission line with a single "Q-bar" section would require a section of about 3,500 ohms characteristic impedance,

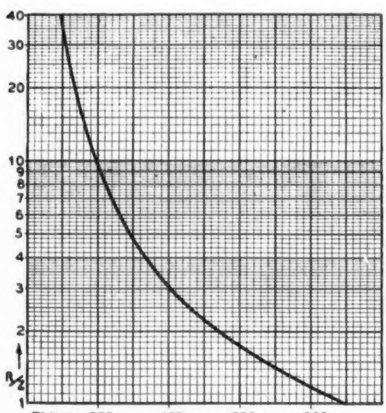


FIGURE 3. R/Z VS mX WHEN X = 0

which is out of the question. If we attempt to use two sections in "series," we find that the ratio of characteristic impedances must be 5 to 1. It would be possible to build two lines, one of 800 ohms impedance, say, and the other 160 ohms and make them work; but it would be awkward. As more half-wave sections are added to the flat-top, the impedance at a current node will be reduced because in such an array the sections seem to act as if they were in parallel. Hence, for a flat-top of several sections it might become possible to use a single "Q-bar" section for matching.

Eliminating Antenna Reactance

The reactance of an antenna may be changed by pruning and splicing on. For a given frequency the reactance vs. length curve roughly resembles a tangent curve, as shown in figure 4. The part of the curve crossing the axis near

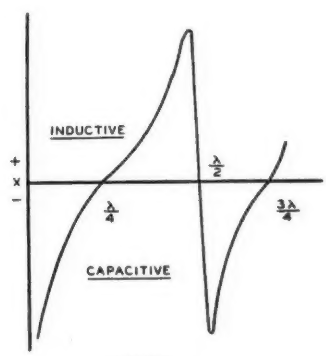


FIGURE 4.

the half-wave length is steep; a few inches may mean a lot. In adjusting for zero reactance an antenna which is to be fed at a current node, we see that a capacitive reactance means we should prune; if its reactance is inductive, we must splice on. On a flat-top beam of two sections, it was found that for a five-foot change in overall length of each wire, the length of the antenna plus the folded length of the 3λ/4 matching section did not vary more than one foot. That is, if one foot were taken off the length of the antenna, it was necessary to increase the stub length six inches. Throughout this pruning and splicing, x remained constant. Knowing this, we can look at figure 2 and find the d which, for this constant x, we will have when X is zero. Then, having this d, we can easily figure out how much must be spliced on or off to make X zero. This has not been tried on other antennas, but it is very likely that x and the overall length will remain practically constant with other types too, and allow this short-cut in getting the right length.

If the shorted quarter-wave line is to be

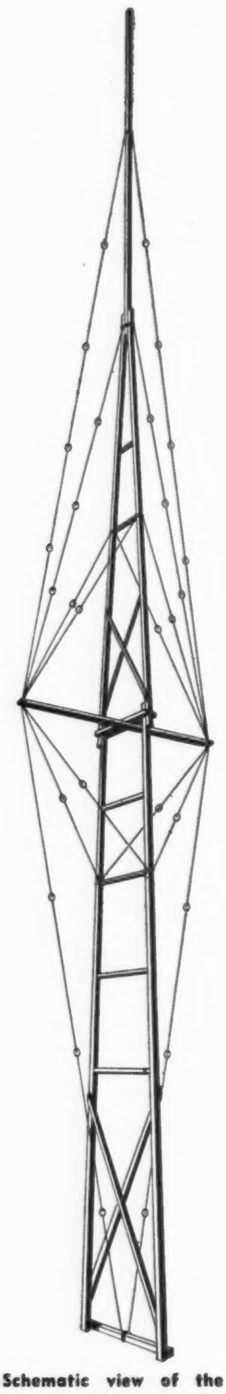
[*Continued on Page 86*]

[4] J. D. Kraus, "Small But Effective Flat-top Beam," RADIO, p. 56, March 1937.

J. D. Kraus, "By Popular Demand," RADIO, p. 10, June, 1937.

A 70-Foot SKYHOOK

By L. J. JENSEN,* W9MIQ



Schematic view of the mast, showing the method of trussing and internal guying. External guys not shown.

After thirty years of being a sucker for every new stunt in sky-hooks, satisfaction has been attained!

From iron pipes heaved on ridge poles of sundry living places to flag poles, gibbets for vertical radiators, lattice towers and wiggling bamboo fishing rods; to steel towers and telephone poles with trucks, man power, and heavy outlays of cash, I swung back to a variation of the old faithful two by two's of yellow pine. It's cheap, a seventy-foot mast costing less than seven dollars; it's strong, a medium weighter can climb half-way up with safety; prairie winds find no resistance; and it's light. None of that "ten expert pole raisers promised and no one around" when the work begins. Two lightweights, a jig pole or handy tree, a stout rope and one pulley, and the thing is up . . . in about an hour.

The photo and the constructional diagram tell the story. Five yellow pine 2″ by 2″, 26 feet long, standard from a local yard, and about a dozen odd lengths of the same, ranging from three to five feet, were selected for lack of knots. One 2″ by 4″ eight feet long was chosen for a cross arm, and four pieces of 1″ by 2″ strips seven feet long. At the "five and dime", lag bolts 3$\frac{1}{2}$″ by $\frac{3}{8}$″ and 5″ by $\frac{3}{8}$″, two quarts of cheap outside white paint and a ten-cent brush completed the actual investment. The whole outlay for accessories was slightly under four dollars.

The long lengths of 2″ by 2″ were laid out, two for the lower section, two for the middle, and one for the top; and each section lapped about four feet. Each joint had three lag bolts. Then the cross pieces were fastened—the bottom one was bolted, but the others were inset. The joints were reinforced with flat pieces of binding steel. Finally, the light, diagonally-placed braces were bolted cross-wise at the base and at the first joint of the second section.

The business then lies like a piece of jelly . . . one heave and it bends like a piece of rope. And that is where the 2″ by 4″ comes in. This was bolted securely, which means to cross-arms and to the uprights, as indicated in the photo and diagram. Small holes were drilled near both ends of the 2″ by 4″ to take the anticipated cross strut guy wires.

Before any attempt at trussing was made, the whole

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Kansas City, Missouri.

business was given two coats of paint; this not only improves the appearance but prevents the decay of materials after a few months of heat, wet or cold.

A thousand-foot roll of no. 12 galvanized iron wire and a basket full of the brown porcelain strain insulators were purchased for less than $2.00. Then the wire trusses, broken by insulators an average of every six feet, were fastened. Turnbuckles were employed, but they are to be used with caution as they are a hazard in the raising spree; they always pull out or unravel at the wrong moment.

The trusses were run from the bottom to the outer limits of the 2" by 4" cross arm: from half way up the bottom section to the cross arm, from the top and center of the second section to the cross arm, and from each side of the center of the top section. Each truss wire was bound tightly around the joint it occupied, but the tying loops were left with merely one or two turns. Then, when all trusses were in place, each binding point was drawn up tight.

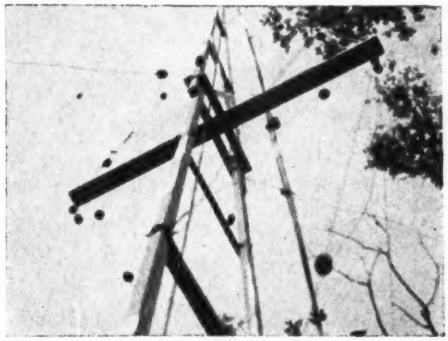
Two pulleys and two ropes were fastened at the top, and then the mast was swung, single-handed, on the cross arm to the point selected for the base. For a base, two building foundation stones, about a foot in diameter and three or four inches thick, were sunk in the turf. Two pieces of old water pipe were driven in the ground beside the stones and the base of the mast tied with rope to the pipes.

The guy wires were attached next: three from the top, one running to the front and two to the back; another three at the top of the second section; and two from each side of the cross arm at the top of the first section. After the mast was up, another guy wire was added to the center of the lower section to overcome a slight twist in the base.

Everything is set to go now. Two middle-weights can raise the job with a little effort; three would make it easier perhaps, but four or five are just a nuisance.

Set a jig pole, with a pulley at the top, twenty to forty feet behind the base of the mast —the distance depends on how much rope you have. The simple thing is to line up a handy tree. Tie the rope *around* the mast at the cross arm. Middle-weight number one handles this position. The other hefty operates at the upper end of the mast, aided by a rake and then a twenty foot length of ladder, to raise the tip as the rope man heaves.

Everything will be smooth sailing until the upper joint of the second section gets about



Looking up the mast. Note the truss cross arm.

thirty feet off the ground and the top begins to dangle in a breath-taking manner. Then the hefty on the top end must scurry around and temporarily tie down the front guy wires . . . all of them, at the points he guesses will be about the right lengths when the mast is vertical (this can be figured out beforehand by the use of a little trigonometry). When that is completed, he takes hold of the rope fastened to the top of the mast and travels backward to straighten the upper section.

This is the critical moment, but if both heavers will move quickly and together, the mast literally can be jerked up to a vertical position. You cannot delay—pull together; and it stands! After that, it is the dreary task of sorting out the remaining guys, aligning the mast from all sides, and straightening out the pulley ropes for the aerials.

•

Another Method of Raising a Flexible Mast

Mr. Jensen suggested one method of raising a tall, light mast. In the following article there is suggested another method. This latter method is well suited to the raising of any tall mast whether it be of the semi-rigid type, as suggested by Mr. Jensen, or of the very "floppy" type as used in the RCA experiments.

The greatest strain that many tall, well-guyed masts of light-weight construction must stand often comes during erection. An ingenious method recently was used by RCA engineers[1] which for many amateurs will solve the problem of getting 60 or 70 feet of gutter-pipe or 2x2 into the air, and without a lot of help from the local assortment of straw bosses.

[1]G. H. Brown, R. F. Lewis, and J. Epstein, "Ground Systems as a Factor in Antenna Efficiency," *Proc. I.R.E.*, June, 1937.

The mast in question used 2.5 inch, galvanized iron pipe in sections of 20 feet plus 10 feet at the top, five sections thus reaching a height of 90 feet. Five sets of guy wires were used, one at the top of each section to remove the strain that might come at the coupling. Two sections of pipe were used as a gin-pole, their height being about equal to the distance from the mast base to one guy anchor. The tricks involved are these: (1) the length of all guy wires is accurately calculated in advance by scale drawings or trigonometry, and guys are fastened securely to their anchors except for one set which goes to the top of the gin-pole; (2) the gin-pole is allowed to be lowered as the mast is raised, using blocks and tackle fastened between the top of the gin-pole and the anchor provided for one set of guys.

Figure 1 shows a top view and figure 2 a side view of the layout on the ground, except for the set of guys beneath the mast, which will not come into play until the mast is vertical. Don't forget to lash the bottom of the gin-pole to the bottom of the mast so that neither will slide, and to put a guy from the gin-pole to each side guy-anchor.

Now as the tackle is hauled in, the gin-pole and one set of guys are pulled back and down, and the mast comes up. The side guys on both the pole and mast keep these from falling sidewise. The back guys of the mast hold it from going too far when the pole is brought down to the ground. At this point, the guys attached to the pole are transferred to their anchor, and the pole and tackle removed.

If your figures are correct and the tackle good, you might do the job alone! Anyway, we know of a fellow who built a heavy 70-foot mast using 3 parallel 2x4's, raised it with little help by using a couple of automobile jacks—but it took him three weeks of spare time. The hinged gin-pole system is much quicker!

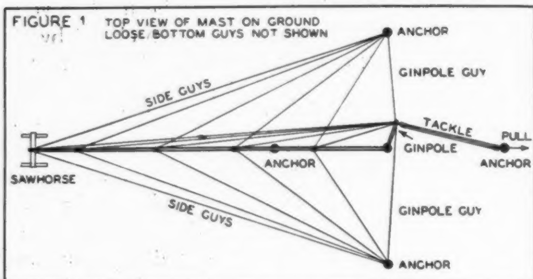


FIGURE 1 TOP VIEW OF MAST ON GROUND LOOSE BOTTOM GUYS NOT SHOWN

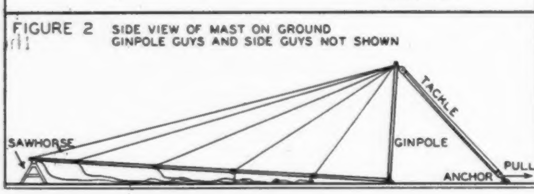


FIGURE 2 SIDE VIEW OF MAST ON GROUND GINPOLE GUYS AND SIDE GUYS NOT SHOWN

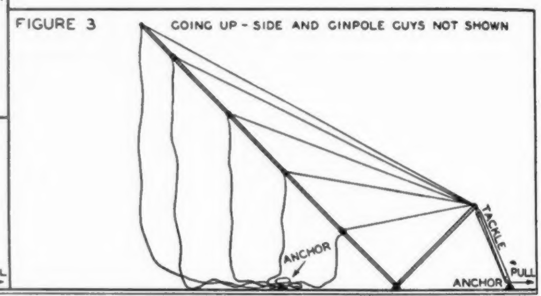


FIGURE 3 GOING UP - SIDE AND GINPOLE GUYS NOT SHOWN

Concentric-Line Antenna

An interesting new type of concentric-line fed antenna is being manufactured by the Western Electric Co. for use at u.h.f. police stations in the 30-42 Mc. range. The arrangement is simple enough and with slight modification would make a very efficient ten-meter radiator.

The basis of construction for the system is concentric transmission line of the copper tubing type. At the terminating point of the transmission line a ¼-wave length of copper rod is run vertically upward; also at this point but running downward is a ¼-wave length piece of copper tubing somewhat larger than the outside diameter of the transmission line. This bottom tubing section is co-axially supported about the transmission line while the top half of the radiator is in the clear.

The outer conductor of the transmission line is connected to the lower tubing section of the antenna while the center conductor of the transmission line is connected to the vertical rod part of the radiator.

A similar arrangement with appropriate dimensions should make an admirable antenna system for amateur use on the 28 and 56 Mc. bands.

HORIZONTAL RHOMBICS . . .

Their Proper Adjustment

By

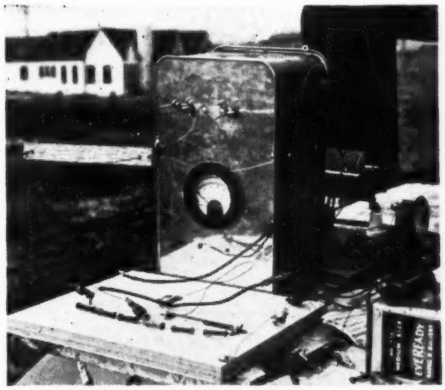
MORTON E. MOORE[1]

& F. L. JOHNSON[2]

The horizontal rhombic antenna has come to be recognized by the amateur as one of the finest directive systems, and hundreds of them are now in use. It is paradoxical, considering the popularity of the antenna, that so much trouble is encountered by amateurs in really getting the most out of these very antennas.

The answer to this point is that the diamond, even when not properly adjusted, will still function in a manner that makes it acquit itself very favorably in the eyes of one accustomed to the more conventional half-wave antenna. Thus, most amateurs do not realize the *full* performance possibilities which may be had from these antennas when *properly adjusted,* and they, therefore, make no effort to adjust them properly. From our experience with these antennas, we believe that the improved results to be obtained through properly adjusting such an antenna will more than repay one for the effort required in making the necessary adjustments

It should first be pointed out that it is necessary really to design the antenna "from the ground up" in order to realize the best performance. The variables in the design of the rhombic antenna are the wave angle (angle of the ray with respect to the ground plane), the height above ground, the side angle, and the length of the sides. In many cases it will not be possible, because of certain construction limitations, to obtain the optimum values of all of these quantities, and compromises will have to be made. It happens, however, in more than a few cases that the compromise antenna compares very favorably in performance with the optimum antenna. All information necessary for the design of such an antenna is to be found in the Jan., 1935, I.R.E. *Proceedings* in an article by Bruce, Beck, and Lowry of the Bell Telephone Labs. Handy charts made from their formulas, which will greatly facilitate the design, were published in the May issue of *QST* for this year.



Close-up of the experimental measuring unit used in the field tests.

Preliminary Design

The procedures in the design of the antenna is first of all to select the wave angle, and from the selected value of wave angle to design the rest of the antenna for optimum performance. Once the design values have been determined, they should be adhered to as closely as possible. An antenna designed for a height of one wavelength above ground will obviously not function as predicted if placed only a half wave above ground. A typical design which would be ideal for amateur operation on 14 Mc. is: wave angle, 17½ degrees; height, 0.83 wavelengths; length, 4.1 wavelengths. A side span of four waves in length will result in considerable strain, and, depending upon the type of masts available, it may be necessary to design for a smaller side length. In general, the longer the side for a given height, the lower the wave angle and the sharper the pattern in both the vertical and horizontal planes. This, of course, means an increase in gain.

Numerous experiments have shown that on 14 Mc., long distance signals arrive as low as

[1] W6AUX, 1418 N. Spaulding Ave., Hollywood, Cal.
[2] W6CNX, 1418 N. Spaulding Ave., Hollywood, Cal.

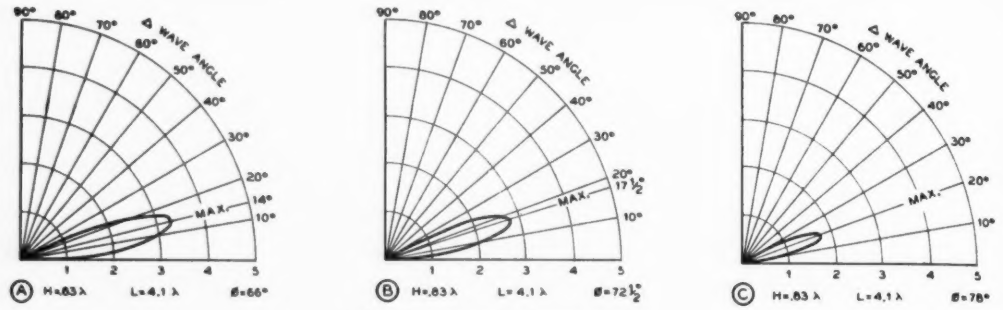


FIGURE 1. RELATIVE RECEIVER CURRENT

The actual radiated power in each of these lobes is the same; the difference in their apparent size is due to the variation in radiation resistance of the array.

five degrees above the horizontal, and it is probable that the *average* angle is about 15 degrees. When designing the antenna, one must, however, consider the coverage which is desired. If the pattern is made too sharp, the coverage may possibly be insufficient for the purpose for which the antenna is to be used. It is, of course, up to the builder to determine the solution of this problem for himself.

Either Broad Vertical Angle or "Steerage Control" Required

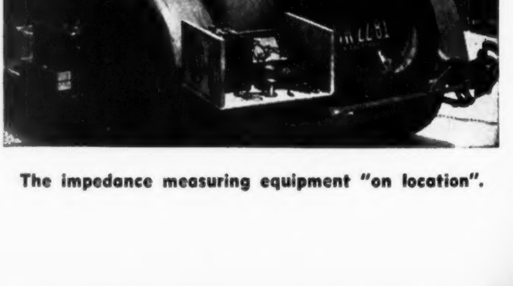
Though the antenna is designed for a definite wave angle, it is nevertheless imperative to make provision for "steerage control" if the best results are to be realized. This necessity arises from the fact that while the antenna may be designed for a certain wave angle, it is not possible to say whether or not this is the optimum wave angle unless a determination of the optimum wave angle has been made. Such determinations are by no means easy to make, and further, the optimum wave angle varies from time to time. It is, therefore, much better to have a flexible system, one capable of taking advantage of changing conditions, rather than a rigid one incapable of being changed as conditions vary.

It is very difficult to determine the antenna height since the sag of the wires and the character of the earth influence this value. The character of the earth will be different for different locations and will influence the radiation pattern. Steerage of the antenna is then the means employed to compensate for the unknown factors (which may be only approximated when designing the system on paper). It also permits optimum performance from the antenna under all conditions. This steerage is accomplished by the pulling in or letting out the sides of the diamond so as to vary the angle at each end of the array.

The effects of steering the antenna are shown by reference to figures 1 and 2. Figure 1 shows the calculated radiation pattern of the antenna for various values of side angles on either side of the optimum side angle.

Figure 2 shows the shift in position of the axis of the major lobe as the side angle is changed. *For every given wave angle there is an optimum side angle for maximum radiation.* This side angle is the complement of the wave angle.

The patterns of figure 1 are not corrected for radiation resistance, and therefore the values of maximum radiation above side angles of 72½ degrees will not be as small as shown nor will the values below 72½ degrees be as great as shown. But the figure does show what can be accomplished by steering and demonstrates its value. The benefits to be obtained from steering will be increasingly greater as



The impedance measuring equipment "on location".

the antenna is made larger, and therefore the radiation pattern is sharpened. With antennas less than $2\frac{1}{2}$ waves on a side, the radiation pattern becomes *so broad that steering is of little benefit,* since the pattern is sufficiently broad to cover most of the useful region without change. The above designed rhombic (or any rhombic designed for 14 Mc. for that matter) will give very good results on either 7 or 28 Mc.

Importance of Terminating a Diamond

The question now arises, "when is a diamond not a diamond?" The answer is, when it is *not correctly terminated.* From the number of such antennas in use which are either not terminated at all or terminated in a manner far from the correct one, it is apparent that but few amateurs fully realize the importance of proper termination of the rhombic antenna. An improperly terminated rhombic represents a waste in time and money, since a V-beam constructed from the same length of wire as used in the unterminated diamond will give considerably more gain.

The idea seems to be in general circulation that the only effect of terminating the rhombic is to make it uni-directional, and that an unterminated rhombic will have just as much gain in two directions as it has in one direction when properly terminated. *Nothing could be further from the truth.* An unterminated dia-

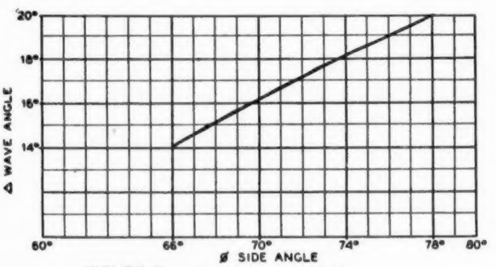
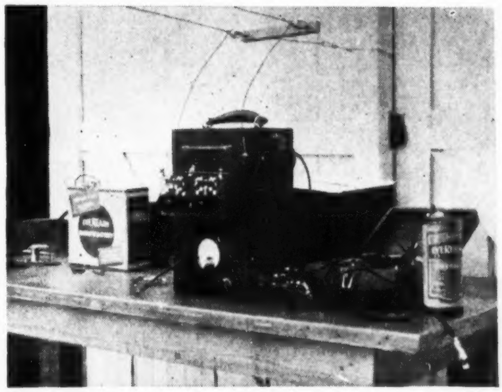


FIGURE 2. H= .83 λ L= 4.1 λ

mond amounts to two V-beams back to back.

Furthermore, the gain of the combination is not so great as the gain from the single V-beam because of the fact that the apex angle of the hybrid V is anything but right. For the antenna heretofore described, the apex angle is 35 degrees, while a correct V-beam with sides of this length should have an apex angle of approximately 51 degrees, a considerable difference. The performance of this hybrid V, designed as a diamond but unterminated, approaches that of the V-beam when the sides are about six waves in length. This does not mean



The Impedance Measuring Equipment. **(See RADIO, October, 1937, p.43.)**

that such an antenna unterminated will have the gain of a properly terminated one, but that the difference will not be as great as with smaller antennas. The diamond is a *non-resonant* system, while the V-beam is a strictly resonant system, as is the "unterminated diamond." Both the V-beam and the "unterminated diamond" have standing waves on their elements. Neither a conventional V-beam nor an "unterminated diamond" has nearly as sharp a vertical pattern as a true diamond of the same size.

Determination of Proper Terminating Impedance

Having decided on the necessity of *correct* termination, the next question before the house is how to solve the problem; and no small one it is either! In order to terminate the antenna correctly, it is necessary first to determine the value of the terminating impedance, after which any of a number of different methods of termination can be used. There are a number of methods for determining the approximate value of terminating resistance which will lead to fair results, but for precise determination and best results it is necessary to resort to measurement of the antenna itself. A device for making such measurements was fully described in the October, 1937, issue of RADIO by the authors. The use of this device in making such measurements is to be highly recommended as it forms the only basis of obtaining absolutely correct termination.

The general criterion as to whether or not the antenna is functioning properly is: standing waves on the feed lines should be small, and the front-to-back signal ratio should be large. The back-end signal response (receiving) should be from 15 to 20 db. under the response

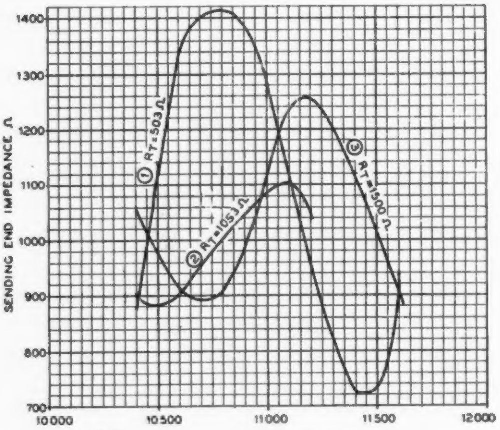


FIGURE 3.

of a half-wave antenna to the same signal, or four to five "S" points.

A very approximate method of determining the terminating resistance is to arrange listening tests with stations on the line of the beam, both in front and in back of the antenna. The frequency of the received signals should be accurately known. A half-wave feed line, or multiple of this length, is brought down from the antenna. A carbon resistor assembly arranged on a rotary switch is used to terminate the line. Resistances might conceivably be in steps of 50 ohms from 700 ohms to 1100 ohms. While the test station holds the key down, an assistant switches in first one and then another of the resistances; the value which gives the maximum response in front of the beam and the minimum response on the back end should be noted. These measurements must be made with an output meter on the receiver. From a number of such tests, an approximately correct value of termination can be obtained.

A much better method is the one employed by the authors. Actually use an impedance measuring device to measure the value of impedance of the sending end of the antenna, since the frequency is varied over a wide range for each of a large number of values of terminating resistance. When a feed line is terminated in its surge impedance, no reflections occur and the sending-end impedance remains constant over a large variation in frequency. However, when the line is not terminated in its surge impedance, reflection occurs, which causes standing waves to appear on the line. Then the sending-end impedance is no longer independent of frequency. The impedance presented at the sending end will no longer have the properties of a pure resistance but will, in general, have reactance as well.

The values of the impedance will oscillate about the surge impedance and will be determined by the line length, the frequency, the line spacing and the termination. The diamond is simply a form of feedline which diverges so that radiation may take place. When terminated in its characteristic impedance, the sending-end impedance will remain constant over a wide range of frequency variation. Hence, to determine the proper termination, all that is necessary is to place different values of resistance in the far end of the antenna and then to measure the sending-end impedance as the frequency is varied over a wide range.

Since in making the measurements it was neither possible nor desirable to place the measuring equipment at the actual physical end of the antenna, a half-wavelength line (1-to-1 transformer) was employed to connect the measuring device to the antenna. Such a line exhibits at the sending end the same impedance as is placed across the receiving end. The line was constructed of no. 20 wire on six-inch centers. This size of a conductor minimized the effects of wind vibration and facilitated the actual physical adjustment of the line length in the course of measurements.

The procedure followed was to set the oscillator at a known frequency, such as 10,000 kc.; cut the feed line to a half wave of this frequency, and then measure the *sending end* impedance of the antenna as various values of terminating resistances are substituted in the *far end.* The antenna can be lowered each time a new value of termination is inserted, or the change can be made by a rotary switch controlled by a string from the ground.

The oscillator is then set at a new frequency, such as 10,200 kc.; the feed line again cut to a half wave at this frequency, and the procedure repeated. This sounds somewhat laborious, but it is a simple matter to make hundreds of measurements within the space of a few hours by using this method.

The results are then plotted and compared. New resistances whose values are close to that of the best value found can then be substituted and further measurements made. A few sample curves for the first trial run are given in figure 3. In this case the best value is in the neighborhood of 1000 ohms, which is surprisingly high. This may be accounted for by the fact that the particular antenna on which the measurements were made was poorly designed and had neither

the correct height nor the correct side angle. One-watt carbon resistors may be used for termination when making these measurements. It is to be noted that at about 1000-ohms terminating resistance, the variation of sending-end impedance with frequency is markedly less than when terminated in a little over 700-ohms resistance. Since a half wave line (transformer) is used in making the measurements, it is necessary that the oscillator frequency and line length be accurately known. Otherwise, error will be introduced.

Requirements of the Terminating Device

Having decided upon the actual value of the terminating impedance, it now remains to obtain a terminating device which will prove satisfactory. The problem of terminating the antenna is considerably complicated by the fact that the terminating resistor must be capable of dissipating powers from a few microwatts to several hundred watts in magnitude without change of impedance. This is made necessary by the fact that the radiation pattern must be left unaltered for both receiving and transmitting; a change of impedance of the terminating device, by causing reflection when it does not properly terminate the antenna, will cause the pattern of the antenna to be different for transmission than for reception. Many resistors change their impedance when called upon to dissipate a large amount of energy. Three methods of termination suitable for use with the antenna will now be given.

Methods of Constructing a Terminating Device

The first, easiest, and, incidentally, by far the most expensive, is to select *large* carbon resistors having the desired resistance and insert them in the antenna itself for the last few feet at the end. They must be sufficiently large to dissipate the energy, which they are called upon to handle during the transmission, with but little heating in order that their resistance may not change appreciably. The d.c. resistance of these resistors can be adjusted to the proper value by utilizing sliding contacts clamped around the rod. The r.f. resistance of such resistors is very nearly the same as the d.c. resistance. The only drawback is that 800 ohms or so of such resistors come to about $30.00, in addition to which they are quite heavy and fragile.

Feed Line Traits

Before considering further methods of termination, let us pause to investigate the properties of feed lines.

When a line is terminated in its surge impedance, no reflection occurs at the receiving end of the line, and the sending-end impedance becomes independent of frequency (at radio frequencies). If the line is either short or open circuited, all the energy is reflected and standing waves appear on the line, the distance between nodal points being a half-wavelength. The only difference between the two conditions is that where in one case there is a voltage node, in the other case there will be a current node.

When the line is terminated in a value of impedance just above or just below the surge impedance, little reflection will occur and the *magnitude* of the voltage and current loops is greatly reduced from the open- or short-circuited conditions. The loops and nodes will have the same relative *position* as when the line was open or short circuited, however. Thus, by varying the value of the terminating device, it is possible to vary the impedance of the line at the sending end, although this impedance may be either inductive or capacitive in nature.

By adjusting the position of the terminating device along the line, it is possible to cause either the voltage or current loop to appear at the sending end. Under this condition the *reactance will be zero,* and the sending-end impedance becomes a pure resistance. Hence, by varying the value of the terminating resistance, we may alter the sending-end resistance, and, by varying the position of the terminating device, we may alter the reactance, making it either capacitive or inductive—as may be desired.

When the resistance of a line becomes appreciable, its surge impedance is no longer a pure resistance, but has the properties of a complex impedance with capacitive reactance. Such is the case for a line constructed of resistance wire, the purpose of which is to obtain a large dissipation of energy in a short length of line. Hence, in order to terminate such a line in its surge impedance, it would be necessary to insert a suitable amount of capacity in series with the terminating resistance. This is demonstrated in the appendix.

Cheap But Satisfactory

We now come to a consideration of the remaining methods of termination, the first of which consists of a feed line constructed of resistance wire such as no. 25 nichrome wire, about 250 feet long and terminated in its characteristic impedance. With such a line, there is little or no capacitive reactance in the surge impedance since the resistance of the line

has not yet become large enough to affect seriously the performance of the line in this respect.

The surge impedance calculated from the formula $Z_1 = 276 \log 2S/d$ should be made as nearly the value of termination resistance required as it is possible to make it. If the value of terminating resistance required exceeds 850 ohms, which is about the highest practical value of surge impedance with this type of line, the sending end impedance may be altered to the desired value by use of the methods explained in the preceding paragraph. The required terminating resistance should not exceed the value of 850 ohms by more than a small amount in even the most unusual cases. If the difference between the required value of terminating resistance and the surge impedance of the line is not great, then the line, when adjusted as explained to obtain the desired terminating resistance, will be rather free of resonant effects.

Some Reactance Desirable at Termination

It so happens that the diamond antenna, because of the nature of its physical construction and its electrical operation, will be best terminated when the terminating device does not present the characteristics of a pure lumped resistance, but rather when it presents in addition some *inductive* reactance to the antenna at the point of termination. This matter has been discussed by Bruce, Beck, and Lowry in their article "The Horizontal Rhombic Antenna" appearing in the Jan., 1935, issue of the I. R. E. *Proceedings*. Hence, to effect the best termination of the antenna, if it is terminated in a pure resistance (either by a feed line or some form of carbon resistors), small series inductances should be placed in the circuit along with the terminating resistance itself.

If the sending-end impedance of the terminating line has been adjusted to a value of something over 850 ohms, as explained previously, the desired inductive reactance can be obtained very nicely by adjusting the value *and* position of the terminating device for the dissipating line until the desired resistance and reactance are obtained. In any event, the best method of termination is to attach the feed line to the antenna, then vary the position of the terminating resistor on the line until the sending-end impedance of the antenna, as measured with the impedance measuring device, remains essentially constant over a wide variation of frequency.

The last method of termination is the least expensive of the three to construct, but also the most difficult to adjust. The construction of the device is shown in figure 4. It consists of a feed line constructed of no. 35 tophet "A" wire (tophet "A" is identical with nichrome 4) spaced 12 inches between centers and having a minimum length of 70 feet. No. 35 wire sounds ridiculously small, but this alloy has surprising strength and such a line is in every way mechanically adequate.

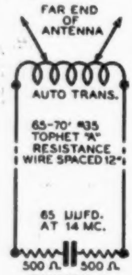


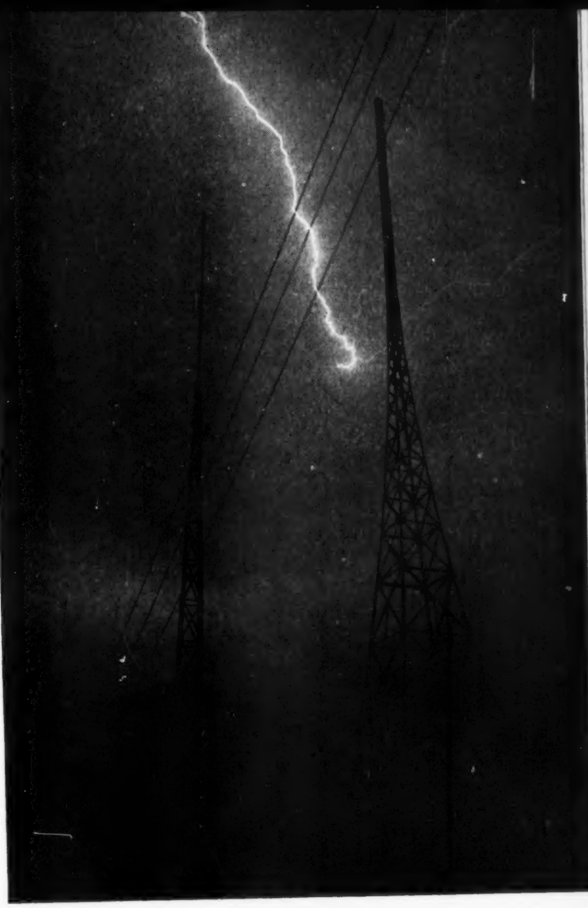
FIGURE 4.

The surge impedance of this line is 1015 ohms. Because of its high resistance, it has a reactive component of 174 ohms at 14 Mc. This reactance will be greater than 174 ohms at 7 Mc. and less than 174 ohms at 28 Mc. The wires are spaced 12 inches apart in order to keep this reactance at a minimum. The line is attached to the antenna through an impedance-matching auto-transformer in order to obtain the correct value of terminating impedance at the antenna. The line itself should be terminated in a couple of small carbon resistors, capable of dissipating 20 watts or so between them, in series with a condenser of approximately 65 μμfd. capacity for 14 Mc. use. For 28 Mc., it will be sufficiently accurate for all purposes if the capacity of this condenser is merely doubled to 130 μμfd. The auto-transformer used to couple the line to the antenna may be constructed of no. 12 enameled wire and may consist of 45 turns, close wound over a 4-inch form.

Those wishing to improve the design of the autoformer may make the coil in three concentric layers, all wound in the same direction, and having a mean diameter of 4 inches and about the same total number of turns. The main idea is to have enough inductance in the coil to avoid loading the circuit and at the same time to have the coil sufficiently compact so that the field of the coil is nearly uniform throughout the coil.

The carbon resistors used for terminating the line should have a value of approximately 500 ohms each. They should be placed in the circuit symmetrically on either side of the series condenser. As the line itself has the characteristics of a capacitive reactance, it will not present the desired impedance to the antenna. Depending on the design of the auto-transformer,

[*Continued on Page 88*]



• Gene Magee, W6NJT, took this striking picture of W6CVW's 104-footer during a recent Tucson, Arizona, thunder storm.

DEPARTMENTS

- Dx
- Yarn of the Month
- 56 Megacycles
- Postscripts & Announcements
- Radio Literature
- Question Box
- The Open Forum
- Calls Heard

The operating position at G6DH with the OM, Dennis Heightman, busily pounding brass.

DX

● DX is a wonderful thing. Now just suppose there were no dx—what would you do? Would you come home from your daily grind and sit down and QSO your pal across town? Or would you park yourself beside the BC set and twiddle the dial all evening in search of something of interest to a dx minded ham? Maybe it's like this: You work all day, on the way home you dash into the nearest "ham gear" supply house and get that high power tube you've been saving for all month. Then you break all speed laws getting home to the shack to install your new bottle—visions of 599x signals are already foremost in your mind. At last you are home, the xyl greets you with the customary greeting together with this, "Oh Honey, what do you think . . . Mr. and Mrs. Kramfuller are coming over this evening to play bridge. Now, do hurry and change your clothes." Oh well! Yessir, dx is a wonderful thing.

W8IGQ and the Yacht Yankee

In a swell letter from Al Eurich, W8IGQ, who is one of the ops aboard the Yacht Yankee, he gives plenty of interesting information. He says that in traveling around the world and stopping at all of the little islands that are scattered around the drink (ocean to you), he has met lots of hams and commercial radio men. It made tears come to his eyes when he got his hands on a few copies of RADIO and started reading all about different isolated stations that had been worked. In other words, month after month, this department has received bits of info concerning rare stations that have been contacted and after a couple of weeks no one ever hears of them again.

This is one time where Al helps everybody out by exploding the myth of some of these stations. It's a case of "Vas you dere Sharlie" and he was. For example, VR6M and VR6AA were both reported many times and they were apparentely on Pitcairn. Al says there just "ain't" any such stations. He spent a week on the island and knows everyone by their first names . . . and even a few family secrets. Anyway Pitcairn is only 1 1/3 miles wide by 3 long and it wouldn't take long to get acquainted. There's only one rig on it and it's a spark job built in the 20's. Al happened to hear the QSO between VR6M and G6NJ some time ago but upon inquiring about any ships in at Pitcairn around that time . . . well, there just wasn't any so whoever it was that has been signing VR6M and VR6AA came from some other location. He saw many cards at Pitcairn waiting for these two stations to claim them . . . so if any of you 'unlucky cusses' mailed your card there . . . just kiss it goodbye.

Now, for you fellows who have hooked with HD2A, FH8AA, FO8ZZ, . . . they are all OK and if you will send your cards in care of W8IGQ he will see that they are delivered and one sent to you in return. FH8AA was at Uea or Wallis Island, as is FW8BP (F3WBP). 175 miles west of Uea is Futuna Island and there is a station on it, FH8BP or F3FBP. Both of these latter two stations are using ten watts and are on 80 meter c.w so . . . mebbe you can get 'em, I dunno.

Right now I will tell you that W8IGQ will be back in U.S.A. sometime in May, 1938, so there will be no use trying to get him now. FO8ZZ is in Bora Bora, one of the Society Islands and was on for a short time. FU8AA is R. Thevenin, Norsup Radio, Makekula, New Hebrides, and has done some ham operating but is mainly doing some broadcasting in the 40 meter band. (Hey, Grand Island.)

Probably the only active ham there in the group is YJ1RV, F. H. Harvey, Vila, New Hebrides. YJ1RV told Al that he thought someone had been bootlegging his call and it probably was some one on the West Coast as he hadn't ever worked U.S.A. He thought he would be able to soon as he had ordered a 50 watt job from W and would be on both c.w. and fone. Al says he didn't have much of a chance to stay with him as he had to travel 24 miles through jungle to get to his shack, from where the "Yankee" was anchored. Even then he got stuck in the dark five miles from "home". (Wonder if he saw any of those pink elephants or green eyed monkeys?)

Now then to the Solomon group which includes the island of Santa Cruz. At Vanikoro is VR4CW who will probably be leaving the island soon for other parts . . . but at Tulagi is VR4BA. He is an old time VK and is using ten watts. His QRA is oke in call book. In Tulagi, is, also, VR4AD and can be addressed: A. W. Rickes, The Treasury, Tulagi, B. S. I. He is the QSL bureau for VR4 and will see that all cards are delivered. There is another station in B. S. I. on a different island at Diamond Narrows. He is VR4HR, H. R. Robertson, Gizo, B. S. I. and manages a cocoanut plantation for the people who make Lux soap. At Port Moresby, Papua, Al bumped into VK4KC. He has been on quite a bit and if I remember correctly ol' 8CRA was the first to get him.

Now to Christmas Island . . . the one near Fanning . . . there is a guy who has been signing VR1XI. He has been working ZL's and K6's but no W's. When he and Al got together he took a squint at

by

HERB. BECKER, W6QD

Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, Calif.

Al's call book and noticed the prefix for Christmas Island was ZC3. Al told him it was probably for the other Christmas Island near Singapore, but he said it would do for him OK as he wasn't official anyway. (Alright fellows, what call do you want?) The old K6KKR in Samoa is no more . . . so cross him off. The only station in Tahiti is FO8AA and the QRA is ok in the book. They do most of their work as an experimental BC on 7100 kc.

If you want to QSO Al you might be able to do so. The call is WCFT and they have two frequencies . . . 8300 and 16560 kc. At the time of this writing the nightly sked is at 0900 g.m.t. on 8300 kc. and if conditions are n.g. he shifts to 16560 kc. at 1030 g.m.t. The skeds carry a quantity of traffic work with several W stations, W1ZB and W1FTR, etc., and as soon as the traffic skeds are through, Al will CQ and add "ANS 20" or "ANS 40" as the case might be. Then when he signs from the CQ he will look for W stations in the band indicated. Incidently the rig on the "Yankee" is an MOPA with 801 Colpitts and four p.p.p. 801s in the final . . . antenna is a 44 foot Marconi. Guess ol' W8IGQ is having quite a trip and we'll give you more later.

VE4ABP is getting all fired up with dx and a few of the ones that made him that way are . . . U9MI, YM4AA, EI4J, VP2AT, PY2EA, PY1FF, U1AD, PA0AZ, VO3X, OZ2M, OE3AH, OE7JH, FA8BG, OH5NF, J2MU, J5CC, ON4NC, ON4FQ and lots of Gs, Fs, Ds, etc. VE4ABP uses a 210 with 60 watts. He wants to know how much a California kw. is . . . and how should I know. I always thought a kw. was 1000 watts. Zat right???

Here's a s.w. listener in England who goes in for dx phone reception in a big way. He is name is Bob Everard and to date has received over 1520 QSL letter verifications from 92 countries, all heard on phone. Bob has recently completed his h.a.s. (Heard All States) on phone only. The one in Nevada was W6BIC. He also possesses the "Popular Wireless" certificate with 5 gold seals for verification of 17 out of the 18 world zones on phone. Everard has received over 200 QSL's stating that he was the first in Great Britain or Europe to report their phone. I'll say that Bob really has been hearing the stuff and he has a list that would choke an ox.

W3EKZ of Baltimore, Md., has been using a pair of 50T's and has done quite well with them . . . YR5KW, YR5AO,SP1DE, SP1EB, CN8MI, OH5NK, GI6TK, U6WD, OK1LH, OE7JH, I1IS, SU1HB, VP2AT, OZ7SS, OZ7CC, CT1MM, OK2BA. W3EXB hooks AA5CN who gave his QRA as Tanger, North Africa. He was T6 and about 14450 kc. (I mean the AA not W3EXB.) EXB has been doing well on ten also, with VU2CQ coming through on 28280 kc. and ZE1JJ is in there too. Best of all for rarity was probably FQ8A who Francis says is T5 and starts on the low frequency edge of the band and drifts out about 100 kc. Gee, get that old crank goin' and go get him.

W9AJA has not been asleep as he worked U6SE in Tiflis for zone 36 . . . that is his 36th zone. New countries for Neil are PK6HR, VQ3FAR, I1IR, YL2CD, K6OJG, YU7AE, and that makes him 97. W2JVU says miracles do happen and this is his miracle . . . he was in a QSO with a W6 and was complaining what a heck of time he has had trying to contact Africa . . . and then upon signing with the W6 he tossed out a "CQ DX". ZT6Y came back. Five minutes later after W2JVU "came to" he heard CN8MS in a CQ, so he gave him a call. CN8MS came back. This almost got him, but he came back for more and now he says that he works a new country nearly every day. Now there, gang, there's a lesson for you . . . just don't give up. If you don't hook that guy the first time . . . just take a tighter grip on that key and pound it harder than ever . . . you'll get 'em, even if it's a W9.

W6MCG recently moved to a new QRA . . . 1600 feet above Hollywood and has been doing good work with his 225 watts. In one month he logged 81 Europeans and a bunch of Africans and other dx. This was on 14 Mc. c.w. and he uses a "Q" antenna 3 half waves long. W9PGS who uses a pair of 801s in p.p. with 100 watts input really has been doing himself proud by working U9MJ, TF3GM, YR5CF, VP1WB, HA1C, FA8IH. During the dx tests he made 33,600 points although going to high school.

• The following data supplements the list sent in last month by W6OCH for phone men out after dx. See page 63 of the October RADIO for further information.

Time p.s.t.	Station	Frequency (kc.)	Time p.s.t.	Station	Frequency (kc.)
8:40 p.m.	HC1JB	14450	8:00 a.m.	XU8MC	14030
11:00 p.m.	GM6RC	14252	7:15 p.m.	HH5PA	14030
6:40 p.m.	YV5ABF	14005	7:30 p.m.	HK1DG	14080
7:15 a.m.	PK3AA	14350	3:20 a.m.	ZP2AC	14000
7:00 a.m.	VS1AI	14010	8:20 a.m.	K4SA	14185
6:15 a.m.	PK1RI	14350	6:50 a.m.	VS3AE	14235
6:45 a.m.	XZ2DY	14350	6:10 a.m.	PK4WS	14150
7:30 p.m.	HK1CK	14140	1:25 a.m.	VP5AF	14265
7:30 p.m.	HK1JN	14140	5:50 p.m.	CX2AK	14060

Eileen Heightman, the XYL at G6DH.

Here's OX2QY

OX2QY is located near Etah, Greenland. Etah is 78 degrees N., 72 degrees W. The operator is W2QY and will be up there for a period of one year studying WX etc. He is using 400 watts into a 12 Mc. rhombic. Already he has worked a number of fellows and this is a good chance to add another country as well as a new zone. He is approximately 14375 kc. T9x. Here's a funny one . . . OX2QY called CQ and was answered by W8ISK and W2WC, of course along with scores of others . . . and 8ISK got him and took all his traffic. The next morning W2WC called CQ and W8ISK came back with a QSP of all the traffic from OX2QY. Incidently this one make 30 zones and 72 countries for W2WC.

From Wilmer Allison, W5VV:

"Have hooked a few good ones (at least for me) such as: (these are on 20): FP8PX, S3 T6; FT4AE, S4, T9, 14405; YS2B, S8, T8, 14425; CT2BE, S7, T6; CR7AW, S7, T9, 14296; ZE1JG, S6, T9; YI2BA, S8, T7, 14260; XU8BRL, S5, T9, 14300; TG1S, S5, T8; U9AC, S4, T7, 14450, he is at Tomsk and is one of the more difficult zones. TG1S has now gone back to school and so the boys that were not lucky enough to hook him will be out of luck for a while as far as that country is concerned. One that I am most proud of is VS4CS S7, T9X, 14270."

A line from Eric Trebilcock, BERS 195, shows he is still active although now located in VK8. He saw both Amelia Earhart and Fred Noonan two days before they disappeared into space. Eric adds that the wx has been perfect but is looking out for their wet season soon . . . the average being 60 inches per year. Such dampness. He brings out that in his listening he found that W6LYM was the loudest and most consistent.

Eric says that ZS3D sent him a card in 1934 so ZS3 is nothing too new. ZS3D is now located in Canada and is VE5MZ. Another item of interest is that the station signing VK5NO near 7300 kc. is the base station of the Mackay Aerial Exploration Expedition and is located at Tanami in North Australia near VK6. The op is Eric Ferguson, VK2BP, and it is tribute to ham radio that Mackay, a wealthy Australian, has chosen a ham as his operator. VK5NO uses fone and c.w. and would probably be heard from 0700 to 1200 g.m.t. on 7 Mc. The expedition is exploring the hitherto unexplored country in the VK8 section. Eric gets a kick out of the fast growing W9 call letters.

40 Meter DX in December

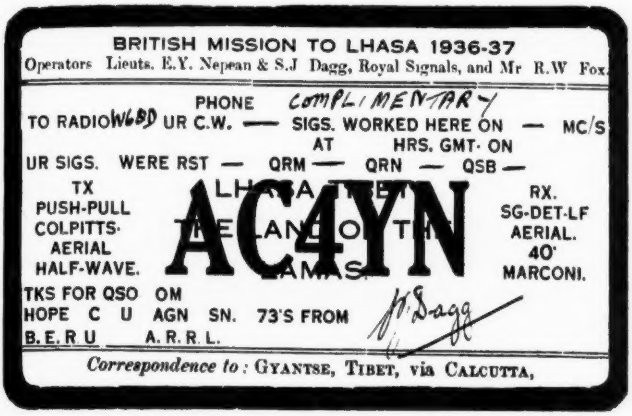
Since the splash about getting on 40 in last month's column, we have received many reports from the gang who are all for giving it a try. Just remember during the entire month of December let's give our 40 meter tank coils a workout. Whenever you QSO a dx man on 10 or 20 between now and December tell him about it and that you will sign off with, "I'll see you on 40 in December." If enough of us give it a whirl—that is, enough of the dx gang throughout the world, I'm sure we'd all have a lot of fun. Then after it was over we would know if ol' forty had gone sour on us or not. Some think it is mostly because the fellows have deserted the band, for 10 and 20, while others believe there is not a chance for any good dx on the band. It will be worth while for all of us, so pass the word around, and when you work someone get him to tell someone else. It will be a sort of an "old home month" and we'll specialize in 40 meter dx. Drag out those 40 meter coils, get your alarm clock in working order, fire up the ol' coffee pot and get ready for some of those old dx sessions on the rip-snorting 40 meter band. You can bet there will be plenty of kilowatts from W6 stations on the band, and yes sir, . . . "I'll see ya on 40 in December."

Last month this department told of W6MEN leaving for Jugoslavia, and that he would probably sign YT6MEN or YU6MEN. Now W3FGO shoots in a card saying that he worked YT6MEN at 7:15 p.m. e.s.t. and that it was his first W contact. W2GVZ worked his 92nd country by getting VP3BG in British Guiana. VP3BG was on phone and c.w., 14,108 kc. Time worked—7:20 a.m. e.s.t. W2GVZ also says ZC1CC was coming in around 7:45 p.m. with a T6 sig on 14,425 kc. Al Cross, W3TR, works FQ8AB for his 78th country. W9KA gets himself a couple of new ones in TG1S and PF2DB. TG1S, 14,430 T7, and PF2DB, 14,300 T9x (where is the PF????).

Snags Four New Ones

W6BAM in Santa Ana lands four new countries, making a total of 90 now. The new ones . . . FT4AG, VQ3FAR, SV1RX, and K6TE on Wake Island. And now W8OSL reports that W6QL and W6BAY are in KA now at KA1YL. Frequency is 14,350 kc. and T9. VE4RO is up to 38 zones and 85 countries. According to W6GNZ, VR4OC uses a 6L6 tritet and a 6L6 amplifier with battery and generator supply. VR4OC is O. G. Chapman of VK2OC and is located at Guadalcanal, British Solomon Islands. VR4OC is T9x and on 14,095 kc. VR4AD is in Tulagi, B. S. I., T9 and 14,035 kc. Both are louder than VK's and come through around 900 to 1000 g.m.t. W6GNZ has 30 zones and 70 countries.

W9DEI picked himself a couple of swell countries to work. CK7FJ and ZM6FT are the calls but he doesn't know where they are. I don't either . . . does anyone know anything about them? Anyway they are both on 14,035 kc. W9DEI says YL-itis and 75 meter phonitis impair dx but he is going to marry the yl and throw the 75 meter coils away. Hi. W6DRE in Phoenix has been laid up for some time and we are glad he is getting up and around again.


BRITISH MISSION TO LHASA 1936-37
Operators Lieuts. E.Y. Nepean & S.J Dagg, Royal Signals, and Mr R.W Fox.
TO RADIO W6BD UR PHONE C.W. COMPLIMENTARY SIGS. WORKED HERE ON — MC/S
AT HRS. GMT. ON
UR SIGS. WERE RST — QRM — QRN — QSB —
TX PUSH-PULL COLPITTS. AERIAL HALF-WAVE.
LHASA TIBET THE LAND OF THE LAMAS
AC4YN
RX. SG-DET-LF AERIAL. 40' MARCONI.
TKS FOR QSO OM
HOPE C U AGN SN. 73'S FROM S. Dagg
B.E.R.U A.R.R.L.
Correspondence to: GYANTSE, TIBET, via CALCUTTA,

No foolin', he really is up there.

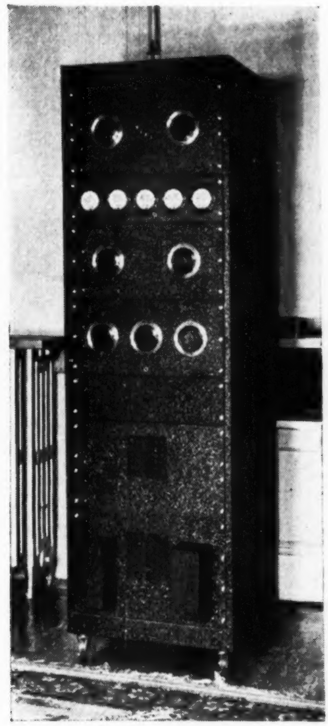
He has gone QRP and uses a couple of 6L6's with about 40 watts input. On 7 Mc. he has worked about 50 VK's and on 20 has hooked with a bunch of ZS, ZU and ZT, KA1AN, CR7AW, ZE1JI and ZE1JG. On ten meters he worked F8RR, ZS2J, LU6AX and G2GC. W6DRE says he is putting up a new skywire . . . one wire 350 feet straight out, and then later on is putting up 4 more of the same. That's in the wide open spaces.

G2YL writes that Miss Zandonini of W3CDQ paid her a visit in London the latter part of July. W9FM asks if that would be a ham fest or a hen fest. John "atom-buster" Kraus, W8JK is doing a swell job working everybody with his new rotary flat-top beam. John was wondering how he could get it on top of a fifty foot pole. His father was wondering how he would get it to *stay* there. Keat Crockett is still at it. At W9ALV he has piled up a bunch of new stuff such as K6OJG in Guam, PK1CRM (ship in Borneo), YS2B in Salvadore, YR5EV, YR5CF, LY1S, VS6AZ, K6LHA and K6TE, CN8AR, CN8AG, CR7AW, XU8RL, UK8IA (Tashkient), YR5AT, YU7TE, J8CF, J2NF, ES7D, HA5J, HS1BJ, and FY8E.

FI8AC in French Indo-China

This is a new one for you fellows to go after on both phone and c.w. He comes in on 14,265 kc., T9 and very loud and steady in W6. FI8AC has been showing up around 1430 to 1530 g.m.t. The other a.m. he said to have the fellows send cards to him at P. O. Box 13, Hanoi, French Indo-China. On c.w. he runs 50 watts and on phone 20 watts. W6NNR was fortunate in not only being the first phone W station FI8AC ever worked, but the first W phone he had ever heard. W6NNR, Guy Dennis, used to be 6CR in the old days and since coming back into the game is doing some mighty fine dx on phone and c.w. Guy uses a single 250TH with about 600 watts input, the antenna being a rotary signal squirter on top of his house. Anyway, this FI8AC puts in a swell sig and it's a good chance to land him.

The other morning when the W9's were tough to work, I bumped into SU1WM. He said he was gunning for K6's especially and also W6's. He has heard K6JPD, so you K6's lend an ear. He wants it known that he will be on quite regularly during the winter on 14,402 kc, between 1430 and 1630 g.m.t.



A neat looking job. The rig at W2BJ, Brooklyn, N. Y.

Our friend ON4VU has now worked 32 zones and 76 countries, his new ones being OA4AQ and XU8XZ.

Those two dentists, W6MLG and W6FTU ganged up on the rest of the big phone stations and worked FB8AH in Madagascar. MLG was the first W6 and FTU the next . . . mebbe they were the first W's, I dunno. Anyway they are running around 250 watts and a k.w., respectively, and both are using these rotary signal squirters. You know, these antennas are really going to town in this neck of the woods and making some of these boys around the country with long wire beams look silly. They consist merely of a half wave Johnson "Q" with a reflector placed a quarter wave behind. That part isn't hard but the methods these fellows use in mounting the thing on top of a pole or tower is worth the price of admission. One of them has his antenna about 100 feet from the shack and controls the rotation by a very low geared motor. Just pushes a button and stops it where the signal is the loudest. Others have a sort of an arrangement using rope and pulleys and the shack end is rigged up with a wheel for steering the antenna. All of them are equally effective and surely are producing results.

Larry Barton, W6OCH, has also worked FB8AH plus a couple of other new ones for him . . . VQ8AS, HS1BJ. Larry has 28 zones and 60 countries now.

French West Africa

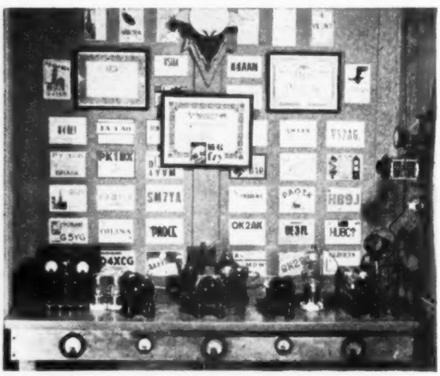
W9QI has added three zones to his total. He now has 24 on phone and the three new ones were I1IT, OQ5AA, and YI2BA. W9QI has also been working ZU6P on both 10- and 20-meter fone lately.

W9CWW who is on c.w. has added a few new countries and zones to his list. Now it is 35 zones and 70 countries. The stations who helped do this are FF8AH 14320 kc. T6, who really is CN8AH temporarily located in French West Africa. Send your cards to CN8AH.

VP2LA 14030 T9 in Santa Lucia is another. W9CWW also has worked U9AW 14420 k.c., and U9AC 14416 T7. Charlie says he has spent most of his time lately calling YI2BA 14280, VS7RF 14320, and CR7AW 14300, and if there are any fellows who want to join him in calling these birds, they are cordially invited to do so. As long as we are talking about the sins of W9's, we might as well bring in another one . . . this time the victim is W9KHD. It seems that 9KHD goes to Dartmouth and was one of the ops at W1ET located on the campus.

W8KPB also attends the same college and between him and 9KHD they work dx from W1ET. So far I have never heard of any classes they attend but let us hope they do . . . or maybe they are majoring in the "Fine Art of DXing". Anyway getting back to 9KHD . . . he came home for the summer and put a 100TH on the air with the help of 9KHG. Running 400 watts they worked 39 countries between July 15 and September 15. Some of the best are U6SE, W10XDA, CR7AP, CT2BE, CX2BK, FA8AB, FT4AG, HA2D, I1IR, I1RCN, I1ZZ, J5CC, OE7JH, OH2PS, SM6QP, YR5CF, ZS1AH, ZT6Y. He has heard ST2LR, 14310, and ST2CM, 14350, but couldn't get either of 'em. Also worked a guy who signed ZQ5S . . . but I guess it's just another one of those things. Yeah, dx is a wonderful thing.

W3EVT had a visit from W6KRI while he was wandering around the country this summer. Says KRI told him all about the California Kws. Well, well and well. 3EVT popped his HV transformer so is QRP for awhile. On August 23 he worked U6AN who said his QRA was in Krasnovodsk which is in



'52 buffer, "Gammie" in the final, all the trimmings. W6FZY, Los Angeles.

Asia. W3EVT says that I1TKO is in Washington and that for any of the fellows who have worked him to send their cards to W3EVT, E. Falls Church, Va., and he will see that I1TKO gets them. I1TKO says he has plenty of QSL cards printed but was unable to get more than two pages of his log out of Italy.

W2GFF has got the dx bug and is going after them for sure. He has worked a bunch of Euro-

Bob Jardine, G6QX, a real dx-er. Bob wants it understood that this is one of his passport photographs.

peans and South Americans and now is figuring on a new antenna to improve further his standing. Atta boy. W6IES has 31 zones and 57 countries to his credit and is using a 35T with 350 watts input. His receiver is an NC101X. W2JGF (2 jolly good fellows) has worked some nice stuff on 20 fone and adds that he has heard W4DHZ on fone quite a bit lately . . . and wants to know what this world is coming to. Oh well . . . you know Dave. W2JGF says that in working TG2F in Guatemala the fellow says he is not licensed for phone and to QSL under cover. His frequency is 14318 kc.

W6GCT down San Diego way has been splitting his time on phone and c.w. during the last few months and now breaks out with 20 zones and 26 countries . . . that is, on phone. He has made his w.a.c. and worked a whole flock of Europeans and South Africans plus the usual VKs, South Americans, etc. GCT uses a long wire to produce results. W3AYS is getting a new rig all cranked up for the winter . . . has his exciter finished and now is beginning the final which will have p.p. 100TH's in it. W6TT of Oakland worked HS1BJ in Siam on phone September 22 and, according to HS1BJ, he was his first phone contact with U.S.A. W6PB and W6OCH also of Oakland, and W6ITH in Berkeley were the next to work him in that order.

HS1BJ comes in around 14070 kc. W6ITH works himself another one in HC1JB, Ecuador, on 14120 and 14435 kc. Reg gives the QRA of EA9AH as: Fernando Diaz Gomez, Apartado 124, Tetuan, Spanish Morocco. He's on 14008 kc. and speaks mostly (or all) Spanish.

20-Meter W.A.C. Record

Here's something to try for: w.a.c. on 20-meter phone in 1 hour and 40 minutes. That's W6NNR's latest stunt. He made it on September 28 in Los Angeles. The stations he worked are, in order, OA4AB, CN8AJ, GM6RG, VK3XJ, W6GAT, and J2MI. This is a good record for c.w., let alone phone—and especially for a sixth district phone. To our knowledge, this is the best time for a phone w.a.c. on the West coast.

[*Continued on Page 90*]

YARN *of the* MONTH

THE MELLOW TOUCH

RADIO *introduces a new feature in this November issue—the "Yarn of the Month"—and would like to receive additions for future issues. There should be plenty of good yarns among the ham gang. How about that row with the b.c.l. down the street and the funny way that it ended? And remember the guy that was bootlegging your call and the measures that you took to run him down? The sea-going brasspounders' and the b.c. station operator's ranks should also be rich in good short stories of this nature.*

•

Did you ever notice how nice the old-time tubes are when they're lit up? Take a squint at an 852 or a 211 or even a 210 sometime when they're glowin' soft and the filament transformer's hummin' gently, and see how warm and comfortable they look. Don't it kinda create a soothin' somethin' in your insides—like it's all nice and cozy in the shack and the rain oughta be pourin' down outside with the wind bangin' away and whinin' now and then; a light glistenin' on the shiny parts of the receiver panel and you sittin' there with the cans on your head tryin' to soak up the weak sigs through occasional sputters of static?

If you haven't got the plate power on, go stick your nose over the top of the tube where you can look right down between the grid and filament. Don't it look pretty? Don't it just *smell* good, somehow? Don't it stir up your imagination and make your blood tingle just standin' there lookin' at it and smellin' it and feelin' its heat? You're damned right it does. That's because those old tubes are alive and have souls.

But these here new kind of bottles, with all their grids and cathodes and such, they aren't like that. Everybody asks me what I got against the new tubes, which are bound to be so dang much better, and what can I say? Can I tell 'em they don't *smell* right? That they don't *look* like they was meant for radio hammin'? 'Course not; they'd think I was nuts.

But that's what's wrong, all right. They're too doggone efficient to look homey and comfortable, or to have that smell about 'em that marks a good ole bottle what's put in many a night reachin' out and grabbin' off the bacon for you. They got no personality.

And that's what's the trouble with the whole works. We got young bloods all over the place that ain't got no respect for the dignity of the past. It ain't their fault; all they got is book-larnin'. All they know is isolantite this and link that and split-stator somethin' else. They fuss around about grid currents and modjulation and drivin' power. What they are is Disciples of the Fourth Grid, and they're too danged efficient to be worth anything to anybody but science. But what snarls my whiskers more than anything else is that after they've got their Distortion Specials splatterin' all over the bands, what do they do but talk about nothin'. Nothin' but nothin'! All that work for nothin'!

I dunno. You'd think these young 'uns would foller in the steps of their ancestors. Sometimes I catch myself wonderin' what ever dragged 'em into the game in the first place, if they can't get the essence of good-natured friendliness that used to cling around the ham bands. Mebbe they should oughta have it explained to 'em, like a funny story when some cluck don't get the point. Sometimes it loses its snap that way, but nobody can say I wasn't willin' to give 'em a chance!

The radio shack of a *real* ham has a kind of hominess, what with the tubes glowin' and transformers purrin' contented-like, and tobacco smoke driftin' lazy in the air . . . A little iron or tin stove with a red spot on its stummick settin' in a corner, busy keepin' the place warm while the wind howls and the storm beats outside . . . A couple of ops settin' around arguin' or just chewin' the fat, with mebbe a bottle and glasses on the table . . . Amps in the skywire, rich sigs rollin' out of the cans, and all is snug below and aloft.

That, you modern braves, is the essence of radio, its motive power and its life. Mebbe times are changin' and equipment with 'em, but what you need is to go poke your noses over them tubes and see if you can't smell some of the real thing.

By "Old Baldy"

56 Mc. . . .

Circles the Earth

By E. H. CONKLIN,* W9FM

News sometimes travels slowly, especially when it must be confirmed before announcement. We have just received word from Don B. Knock, VK2NO, Radio Editor of *The Bulletin,* of what appears to be the world's record for five-meter reception.

Cecil Mellanby, radio engineer of Pwllheli, North Wales, British Isles, states that on November 22, 1936, at 7:30 a.m. British standard time, he heard a station on five-meter phone signing "VK2N—" in a contact with another VK station. The signal was R2 to 4, and, owing to high receiver noise level, the last letter of the call was lost. He explains the delay in sending the report as resulting from uncertainty due to the missed letter, but goes on to say that as he has since heard VK2NO frequently on 14 Mc. phone, he recognizes the voice.

Needless to say, Don Knock immediately tore home from his office on getting Mellanby's letter and checked his log. There it was! Between 4:20 and 4:45 p.m. Sydney time, he was working on five-meter phone with VK2HL of Chatswood which was due northwest, the direction for European contacts in the afternoon on lower frequencies. His Reinartz rotary beam was aimed smack in that direction. The three-stage transmitter used a 6L6 oscillator with its output circuit doubling to five meters driving an RK25 buffer, with two 35T's in the push-pull final with 100 watts input.

As Mellanby has already heard a number of U.S.A. stations on 56 Mc., completely verified, VK2NO places every reliance on this report. While British amateurs have already reported reception of Japanese commercial station harmonics on five meters, this reception of an actual 56 Mc. fundamental over a longer path is extremely interesting.

During the Australian summer, which occurs during our winter, there will be considerable 56 Mc. activity among the VK's, with transmitters running automatically for lengthy sessions.

* Associate Editor, RADIO.

XE1AY Gives Data

Getting back to ancient history, XE1AY has supplied the dates of hearing five-meter harmonics in 1935. In October, after having heard signals up to 40 and 44 Mc. on several days, he heard W4AGP's second harmonic on the 17th at around 3 p.m. Central time; it was very weak. On the 20th at noon, he heard a harmonic of W2AUP calling VP2AT, and a commercial harmonic, WPK.

Reports so far received cover 35 days since May 9, 1937, on which the 56 Mc. band was open for roughly 800-mile dx. A few of these reports are unconfirmed. Please make additions to the table on page 89 of the October issue of RADIO as follows: May 9; June 7; July 24; August 9, 16, 18 and 23; and September 19. The data covering June 7 and July 24 was given in W6QD's DX column on page 91 of the October issue. We shall bring you the rest here.

W7AVV in Hillsboro, Oregon, noticed on May 9 that the skip on ten meters was very short, it being possible to work San Francisco all day until 11 p.m. Pacific time. He listened at about 5:15 p.m. and heard a number of commercial harmonics between 50 and 56 Mc. There were a number of crystal-controlled carriers in the five-meter band but none signed, and before he could get any calls, the band passed out. At 10:35 the band was open again for a few minutes; W6CNE was heard R7—this being verified. Several other phones were readable, but the band went out again before the calls were copied.

W9CLH Gets More Cards

In addition to the numerous reports covering August 9 included in the October issue, W9CLH has received cards from W1KQJ, W1KCY, W1DUJ in Maine, Walter J. White in Penacook, N. H., and Samuel Cohen in Salem, Mass.

On August 16th, at around ten p.m. eastern time, W9CLH in Elgin, Illinois, was reported by W3GLF, W3AXR, W3DZD, W3EZM, W3GRM, W2JCY, W3GPU, W3BTQ, W8QVC (in Rehoboth Beach, Delaware), W8QOL, W3DNU, W3CGF, W3GSO, W3CXP, W3DBC, W3EIS, W3AWS, and others.

On the same evening and the evening before, W3DBC in Washington, D. C., also heard W1FHN, W1BCR, and W1AVV. This, together with reception of W1DEJ, W2JZ, W2KLO and W2IQX (W2JQX?) on July 20,

[*Continued on Page 88*]

POSTSCRIPTS...

and Announcements

There are a couple of Pacific coast u.h.f. stations that, since they are operating on a 24-hour schedule, will bear listening for as a possible indication of conditions on nearby amateur bands.

W6XKG, crystal controlled on 25,950 kc., has 100 watts in the antenna and rebroadcasts the programs of KGFJ, a Los Angeles broadcast station on 1200 kc.

Conflicting reports have been received on the usefulness of this station as a marker to indicate when 10 is "hot." Some have said that when 10 is good, W6XKG is weak or gone, and vice versa. Other reports have mentioned the fact that when they heard XKG boiling in, a listen on 10 meters showed this band also to be good. This variation in reports can be explained by the possibility that the critical frequency of the reflecting layer was between 26,000 and 28,000 kc., or by the possibility that the skip distance was enough shorter on 26 Mc. that the station was weaker than those on 28 Mc. at the same distance. At any rate, careful listening and comparison should uncover some interesting conclusions as to the prediction of good conditions on 28 Mc.

The other station, W6XRE, 120 Mc., 15 watts in the antenna, also is operated by KGFJ and rebroadcasts their programs.

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Please Check

An error was made in Appendix 2, page 49, of the article "Impedance Measuring Device for High Radio Frequencies" as it appeared in the October, 1937, RADIO. Under the heading, "For a Series Circuit," in this column, there appears the equation, $\Theta = \tan^{-1} \frac{\Theta}{R}$. This equation should read, $\Theta = \tan^{-1} \frac{X}{R}$. In other words, the phase angle is the angle whose tangent is equal to the reactance over the resistance.

Next Month

Pictured above is the Rotatable Flat Top Beam, by Johnny Kraus, W8JK, originator of the flat-top beam. It has all the advantages of the original arrangement—low vertical angle, sharp horizontal directivity—but these are now usable over a full 360° instead of being concentrated in only two directions.

A large number of diagrams and photographs are shown along with an unusually complete text in the thorough Kraus style.

Another feature of the December issue will be a complete description of a modern design 500-watt phone and c.w. transmitter, rack mounted and completely enclosed.

These in addition to the usual interesting RADIO features.

Don't miss them.

Erratum?

Concerning the picture at the head of the Departments page in the last RADIO, W6CUH, Charlie Perrine, wants it definitely known that he was only on phone for the picture (and it was under the call of W6XKK at that). However, Charlie does work on the technical end of phone at times, and recently helped W6QD, Herb Becker, with a bug or two when Herb put his "Corn-Fed KW" on phone.

NEW BOOKS

AND REVIEWS of CATALOGS

[Books submitted to the Review Editor will be carefully considered for review in these columns, but without obligation. Those considered suitable to its field will also be reviewed in RADIO DIGEST.*]*

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RADIO ENGINEERING, F. E. Terman. Second edition, 813 pages, 6"x9", 475 illustrations. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. Price $5.50 in U.S.A.

Prof. F. E. Terman's first edition of Radio Engineering needs little mention to radiomen throughout the world. Its acceptance as the standard reference text has been unanimous. The second edition has been almost entirely re-written—with the exception of the first few introductory chapters—in the same high standard as the first edition. A new chapter on television has been introduced and a great many subjects throughout the book have been more exhaustively treated.

The new edition has been brought up-to-date so thoroughly that many owners of the first edition will find ample material in the second to justify its purchase.

•

THE INTERNATIONAL BROADCAST AND SOUND ENGINEER; editor, A. L. J. Bernaert, assoc. I.R.E. Distributed in the Americas by Pilgrim Electric Corp., 44 W. 18th St., New York, N. Y. 225 pages, illustrated, $1.50 in U. S. A.

A compilation of information of interest to the broadcast and sound engineer from authoritative sources throughout the world. Some of the more universally interesting articles are translated (in resumé) into the more generally used foreign languages. All the technically active European and North and South American countries are represented by articles written by authorities in their fields. All the works appear in English; some have been made into resumés in other tongues.

•

Catalog no. 372-R, a recent 16-page publication of the Jefferson Electric Co., Bellwood, Ill., contains complete information of the company's line of radio transformers and chokes. The catalog also includes information on public address system amplifiers, diagrams and equipment. Copies are free to those interested in radio.

•

A new 36-page catalog of commercial sound products has been issued by RCA Manufacturing Company, Camden, New Jersey. This catalog should prove valuable to all those interested or employed in public address and sound re-inforcement work.

The catalog includes RCA's new inter-office communications systems, new amplifiers, new portable and fixed sound apparatus, speakers, microphones and accessory equipment. A special feature of the new publication, a cross-reference table, assists sound men to determine the type of equipment required for all of the general types of sound installations.

•

The Cornell-Dubilier Electrical Corporation has announced the release of its latest catalog, no. 153A, which lists and explains in detail the corporation's complete line of mica transmitting capacitors. This catalog is available to anyone addressing his request to the company at South Plainfield, N. J.

Question Box

What is the meaning of the term "r.f. grid current?" I have seen it used quite frequently in connection with manufacturers' ratings on transmitting tubes. Does it have any connection with the grid current as measured by the conventional d.c. grid meter?

"R.f. grid current," "circulating lead current," or "surge grid current," as it is variously called, is just exactly what the name would imply; it is the amount of r.f. current that is flowing in the lead under consideration. Actually, it has no direct bearing on the amount of d.c. current that is flowing in the circuit. However, in most practical amplifiers, with an increase in d.c. current there is an increase in the r.f. current. But this is misleading since it is the r.f. voltage and not the d.c. current that determines the lead current in an amplifier.

The actual value of permissible lead current as given in the tube tables is the maximum current that the electrodes will carry without excessive lead or seal heating. If the circulating current is run much above this value, there is danger of melting-off one of the lead wires or of overheating one of the seals. If the seals become seriously overheated, there is danger of their softening and admitting air to the tube.

This current is due to the charging current that continually flows because of the capacity-to-ground of the particular electrode under consideration. This interelectrode capacity acts as a small condenser shunted across the r.f. voltage at that point. Due to the r.f. voltage and the capacity-to-ground of the electrode, there is a flow of r.f. current. The magnitude of the current is directly proportional to the frequency of operation (due to the reactance of the interelectrode capacity), directly proportional to the interelectrode capacity, and directly proportional to the r.f. voltage appearing across the circuit.

Thus, looking at the paragraph above, we can see what types of tubes will operate best at ultra-high frequencies. The best tube will be one with very short, heavy leads; low interelectrode capacities; and amply proportioned, adequately ventilated seals.

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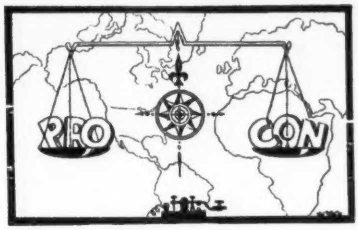
Some friends and I recently were discussing the phenomenon of induction. We became embroiled in an argument as to the correct explanation of this effect. What is the accepted explanation?

This is perhaps one of the most frequently misunderstood electrical effects. It is commonly said and accepted that the "cutting of magnetic lines of force

[Continued on Page 91]

The . . . OPEN FORUM



American Morse Code

Omaha, Nebraska.

Sirs:

I notice on page 92 of your July issue, you have suggested the use of American Morse Code for a "degree of secrecy."

Might I remind you that two of the fellows had their licenses suspended for using this code?

INTERESTED READER.

Editor's Note—The F.C.C. writes re this inquiry:

"The Commission has not adopted a rule specifically prohibiting the use of this code by amateurs for the reason that the extent of its use has been very limited. However, it is felt that the American Morse Code should not be used in amateur communications, except possibly in cases of emergency. Its use for test purposes which would involve communications between amateur stations is permissible but, because of the confusion that may result, its use should be discouraged.

"The Commission's Rules and Regulations, as well as the General Radio Regulations annexed to the International Telecommunication Convention of Madrid, 1932, require amateur station licensees to have a knowledge of the International Morse Code. Its use in radio communication is universal while the American Morse Code is confined primarily to wire circuits within the United States. In view of the confusion that may result from the use of the American Morse Code by amateurs, especially in the transmission of call signals which might be misinterpreted by one not familiar with this code, it is not desirable that it be used for communication purposes."

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More "Coditis"

Fort Omaha, Nebr.

Sirs:

In answer to "Coditis" of your July issue, let me say that I believe Mr. Wellar is quite right—one must be either stupid or lazy if one can't learn to copy 13 w.p.m. Now, I do not believe that Mr. Wellar is lazy, because he said that he has developed himself technically. After studying five years, he should know something of the rudiments of radio.

I will not say that he is stupid for the simple reason that a stupid person could not, under any circumstances, learn anything about radio. In other words, I think Mr. Wellar *can* learn the code.

The trouble with Mr. Wellar is, I think, that he probably does not know how to concentrate and has no proper method of picking up speed.

Let me say to Mr. Wellar: "Forget transmission for the time and listen and try to copy just a *little* faster than it is possible for you to do so perfectly, and keep at it. You will, in time, be able not only to copy 13 w.p.m., but 30!"

LEE POYNER, ex-W9DCB
Signal Corps, U. S. Army (WVU)

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—And More

Des Moines, Iowa

Sirs:

The "Coditus" letter in your July issue attracts my attention, as I thought the subject broached in it had been settled long ago. However, it appears necessary to comment upon it once more.

I believe I voice the sentiments of the entire c.w. gang and a majority of the better phone men when I say simply in answer to the subject question, "No 13 per, no amateur license of any grade to anyone."

I feel forced to take exception to Friend Wellar when he says, "I am one of those poor saps who can't learn the code." From my own experience in learning the code, from watching others try to learn it, and from a little experience in trying to teach it to others, I feel safe in saying I have never yet seen the man who couldn't learn to copy 13 w.p.m. if he really wanted to do so and applied himself.

Fellows in Wellar's predicament are often licked before they start, simply because they believe they just can't learn the code. Their approach to the subject is all wrong. I know, as I said the same thing when I started. In fact, I gave up three times before getting myself to believe that I *could* learn the code.

[*Continued on Page 92*]

CALLS HEARD AND DX DEPARTMENTS

Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor, not to Los Angeles.*

W. Edwin Davey, BSWL330, 2 Fingal St., Woodvale, Belfast, Northern Ireland.
(August)
(14 Mc. phone)

W—5BJO; 5DVM; 5EDI; 5EHM; 5YJ; 5ZS; 6BIC; 6GCT; 6GUJ; 6HQY; 6ITH; 6JKP; 6LLQ; 6OY; 6YP; 6YU; 7ABH; 7AFP; 7AO; 7APD; 7FQK; CE-1AH; CE1AO; CE3CO; CE3DG; CE3DW; CX1AA; CX2AK; FB8AH; HC1JE; HI7L; K4ENY; K6BMC; K6KMB; K6NZQ; K6OQE; KA1HS; KA1JR;KA1NE; LU1EX; LU1QA; LU5AN; LU7AG; LU7AB; OA4AL; O2RAA; PK1MX; PK1ZZ; PK2VD; PK4AY; PK4VR; PK4WL; PY1FR; PY1AC; PY2ET; PY2FF; PY2GC; PY5AQ; SV1CA; SV1KE; TI2KP; VE4KZ; VE4LX; VE4OF; VE5HA; VK2ABD; VK2HH; VK2NO; VK2VV; VK2XU; VK2KX; VK3ZZ; VK4JU; VK5QF; VP2CO; VP9R; VS1AL; VS2AK; VS7RA; VU2CQ; ZE2FY; XE3MF; XG3BG; YL2BC; YV5ABE; YV5ABT; YV5AC; YB5AE; ZE1JA; ZU1PX.

Donald W. Morgan, 2CBG, 15 Grange Road, Kenton, Middlesex, Eng.
June 1 to July 1
(14 Mc.)

W—1DHE; 1EH; 1LQ; 1WV; 2ADA; 2CNO; 2DTB; 2GUX; 2HQA; 2KAP; 2KD; 4DRD.—CT1BQ; CT1CB; CT1CX; CT1DT; CT1QA; CT1PC; CT3AB. — D WCUR; 3DXF; 4JXK; 4KMG; 4SBG; 4SNG; 4WAL; 4XQF; 4XVF; 4ZRA.—ES1E; ES6D; ES7D; F3MM; F8FM; F8NE; F8NR; F8NU; FA3JY; FA8GT; FA8RC; FT3JY; FT4AG. — G—2JU; 2KU; 2TZ; 2UV; 5CU; 5JM; 5LI; 5NX; 5PJ; 5SR; 6VP; 6XP; 6YJ; 8GB; 8GX; 8KH; 8QC; GI2UO; HA1P; HA2B; HA2J; HA3B; HA3P; HA5C; HA5J; HA6A. — I—1EDT; 1GA; 1IT; 1IV; 1KK; 1KN; 1LD; 1LT; 1MH; 1MN; 1ZZ. G5CC; LA2X; LA3A; LA3J; LA4R; LA5S; LA6R; LU3EV; LU4BH; LU4DH; LU4DQ; LU5AN; LU6BV; LU6XA; LU7BH; LU8EN; LY1AD; LY1AN; LY1KK; OE1EK; OE1ER; OE1XA; LE2OP; OE2PN; OE6DZ. — OH—1NR; 1NV; 2NE; 2OI; 2PW; 3NP; 3PW; 5CH; 5NF; 6NS; 6OF. OK1CX; OK1NX; OK1PK; PK2KD; PK2KJ; OK2KL; OK2RR; ON4AU; OZ1L; OZ2PB; OZ5B; OZ5P; OZ9Q; OZ9R; PY1AZ; PY2DT; PY2EA; PY2HM; PY2LJ; PY5BA; PY5QD; SP1AB; SP1BQ; SP1CM; SP1EB; SP1GZ; SP1HA; SP1HJ; SP1OL; SU1GT; SU1DX. — U—1AB; 1BU; 2NC; 3CY; 3DC; 3DZ; 5NE; 5RC; 5UE; 8AW; 8ID; 8MN; 8MW. UK3OA; VE1EK; XI9NN; XU8NQ; YI2BA; YL2BQ; YR5AA; YR5CD; YR5CF; YR5IG; YR5KG; YR5KW; YR5PY; YR5TP; YU1AA; ZB1L; ZB1P.

Andrew J. Ruska, W2KCP, 77 Woodbridge Avenue Woodbridge, N. J.
(July 30 to August 30)
(14 Mc. phone)

HC1JC.

(7 Mc.)

YV4AX.

(14 Mc.)

CN8AES; CN8MI; CN8MS; CT2BE; CX2BE; CX2BK; D3ANK; D3BXK; D3CFH; D3GPF; D4DRC; D4PCU; D4WXD; F3AU; F8AI; F8BS; F8EO; F8FC; F8FE; F8OK; 8TM; F8WK; FA8BG; FP8PX; T4AG; FY8CR; G2GC; G2GF; G2JG; G5AN; G5IU; G5JM; G5LI; G5SY; G8PC; GM5YN; HA2D; HA2Z; HA8C; HB9BL; HC1JW; HH1P; HI5O; HK2EA; HK4EA; I1TKM; K4DTH; LU3DH; LU7AZ; LX1AM; NTZ2R; OE3AH; OH5NR; OK1RO; OK1ZB; OK2BA; OK2MA; OK3TW; ON4BW; ON4CD; ON4FQ; ON4IF; ON4JO; ON4NW; ON4RX; OZ7CC; PA0DC; PA0JJ; PY1DA; PY2CX; PY2LA; PY7AG; SP1BC; SX3A; TF1AM; VK2AD; VK2ADE; VK2VA; VK2ZC; VK3GU; VK5JS; VK5LN; VO4Y; XE1AA; XE1AG; XE1AM; XE1BM; XE1CF; XE3AR; YR5HC; YR5VV; YU7AY; YU7TE; ZL12GO; XL2QA.

L. F. Strobel, W8BSR, 2626 Sixth Street, Cuyahoga Falls, Ohio.
(August 1 to September 19)
(14 Mc. phone)

K6NQZ; VK2AP; VK2DE; VK2UC; VK4JU; VK5GM.

(14 Mc.)

CN8MS; CR7AW; CX2BK. — D—3BAN; 3BXK; 3CDK; 3CFH; 3DBN; 3DSR; 4BEC; 4BFU; 4FND; 4JED; 4QET; 4QNM. EI7F; F3AD; F8RK; F8WK; FP8PX; FT4AG. — G—2HW; 2LA; 2YY; 2ZQ; 5AO; 5FY; 5IU; 5WP; 6GD; 6GL; 6JZ; 6PD; 6RB; 6RL; 6XP; 6YR; 8CJ; 8MY; 8ND; 8TC. GM6NX; GM8MN; LL1P; HK3AL; J2CC; K6GPG; K6LNW; K6OJI; K6SO; LU3HK; LY1S; ON4CD; ON4IF; ON4NW; ON4ZY; OK2HX; PA0AD; PA0CE; PA0EA; PA0GN; PA0KW; PA0KZ; PA0QF; PF2DB; PY2CX; PY3CM. — VK—2ADE; 2ADG; 2AEZ; 2AHA; 2BR; 2BZ; 2DG; 2EG; 2EL; 2FA; 2HF; 2HV; 2LD; 2LP; 2PV; 2QA; 2QE; 2TV; 2XJ; 2XT; 2ZW; 3CV; 3DF; 3HF; 3HK; 3HY; 3IW; 3MR; 3NG; 3OT; 3PH; 3QI; 3QK; 3VB; 3XP; 3XQ; 3ZB; 4EL; 4FW; 4HR; 4LW; 4MW; 4NO; 4RF; 4RM; 4TK; 4TY; 4UR; 5AMB; 5CV; 5GR; 5HM; 5JB; 5JS; 5JU; 5LD; 5PS; 5RX; 5WK; 5WR; 5ZX; 6BW; 6SA; 7BH. VP1AA; VP1NB; VP3BG; VP8AF; YR5CF; ZE1JI; ZE1JN. — ZL—1DI; 1DV; 1FE; 1GX; 1LS; 1MQ; 2CI; 2DW; 2OF; 2PM; 2QM; 3GR; 3KP. ZS1AH; ZS5M; ZS5Q; ZT2Z; ZT6AU; ZU5AQ; ZU5D; ZU5J; ZU5N.

Alan I. Breen, ZL-421, 68 Pine Hill Terrace, Dunedin, NE1, New Zealand.
(June 20 to July 31)
(14 Mc. phone)

W—2IKV; 5EEN; 5YJ; 6MWO; 6YU; 8ANO; 8AYN; 8GLY; 8LSA. CE1AO; CE3DG; CE3DW; CO2EG; CT1AY; CT1OZ; CX2AK; CX3BN. — F—3HZ; 3JD; 3MF; 3OL; 8AM; 8DQ; 8DR; 8KW; 8MG; 8QD; 8WK; 8YG; 8ZM. — G—2BY; 2PU; 2ZJ; 5BJ; 5BM; 5BQ; 5DV; 5LU; 5NI; 5OV; 5PQ; 5QI; 5SP; 5TZ; 5XT; 6CL; 6CW; 6LP; 6OS; 6OU; 6TZ; 6XR; 6YP; 8GM; 8MG; 8MX; 8NJ. GM5NW; GW8HI; HK3JA; K6NZQ; K6OQK; LU4FC; LU4FC; LU4KA; LU7AG; LU9BZ; ON4AJ; ON4BG; ON4MM; ON4ND; ON4VK; PA0AD; PA0EO; PA0FP; PA0UN; PA0WN; PA0XF; PY2BA; PY2EJ; PY2EP; SM5SV. — VE—1LR; 3FA; 4GJ; 4KX; 4WJ; 5BG; 5EF; 5ES; 5HI; 5PT. XE1BZ; XE2FC; XE2FF; XE2BJ; XE2AH; YV1AA.

*George Walker, Assistant Editor of RADIO, Box 355, Winston-Salem, N.C., U.S.A.

Reviewing U. H. F. Propagation

[*Continued from Page 30*]

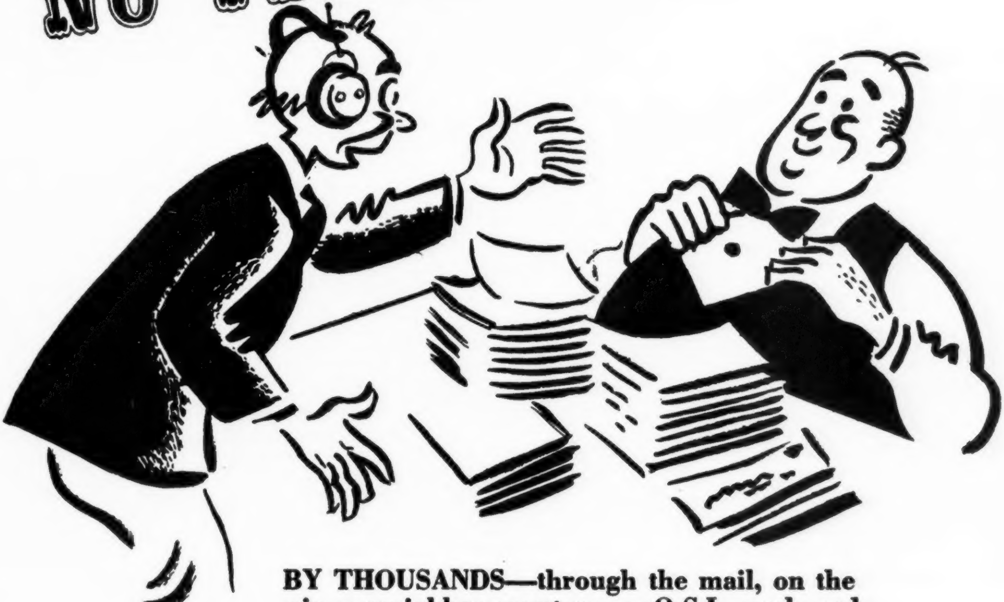
duration and frequency of occurrence of these sky wave transmissions, as well as diurnal and seasonal effects.

There are apparently four mechanisms which may be involved in ultra short wave propagation. These are (1) combination of the direct ray and the ray reflected from the ground; (2) diffraction at the earth's surface; (3) refraction in the troposphere; (4) sky wave transmission.

The first mechanism is the principal effect within the optical path. It shows that the signals are attenuated according to the inverse square law of the distance for grazing incidence within the optical range. The signal intensity can be calculated by simple equations, although scattering and absorption, even in open country, tend to reduce the average intensity to something in the order of 30 to 60 per cent of the calculated value. In urban areas, the scattering and absorption due to buildings, increases the

[*Continued on Page 77*]

WHAT—
NO TESTIMONIALS?



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The Naval Reserve

[*Continued from Page 39*]

the Naval Reserve to increase the regular naval forces. Full information regarding eligibility for membership may be obtained from the commandant of the naval district, from some member of the NCR, or from the Navy Department, Washington, D. C.

The above is purely an unofficial article written by an interested member of the Naval Communication Reserve in an attempt to give the amateur a more clear idea of the function of the NCR.—EDITOR.

Through Europe With a Call Book

[*Continued from Page 45*]

In the first place, the annual radio trade exhibition at Radiolympia was in progress during my stay. It was very interesting to compare the commercial radio developments in England with our own. As far as sound reception is concerned, we seem to be about equal or a little ahead of the English. The all-wave receiver doesn't seem to be quite as general there as it is in the U.S. However, it is in television that the progress is most striking. Many types of teleceivers are offered although the prices are as yet quite high, ranging from $375 to $875. Among the novelties was a thermoelectric battery charger for use with battery sets. This device was advertised to be able to keep a "B" battery charged at all times from the thermoelectricity generated by a gas consumption of two cubic feet per hour.

The second fortunate circumstance was the fact that during the week I was in London the Annual R.S.G.B. (Radio Society of Great Britain) Convention was held there. The concluding banquet of the convention, to which I was invited by G6WY, climaxed most appropriately my series of personal QSO's with European hams. Variations on our usual procedure were the asking of the blessing before the banquet and the toasting of the king afterwards. Another variation from the usual American ham-fest was the fact that the behavior was rather formal with little horn blowing, etc. Otherwise, however, it was not greatly different from our district conventions. There were speeches, the banquet, and raffle—all according to Hoyle. Incidentally, although there was about one prize to every three people, I left the banquet one of the prizeless two-thirds. I have never in my life won a prize at a ham raffle, but I'm still in hopes.

Since I was the only W at the banquet I didn't hesitate to speak up when I overheard a YL telling one of the G's that she was looking for an American amateur who was supposed to be there. The YL was Miss Nelly Corry,

G2YL, who had not been home when I had called her on the phone during the previous week. We had time for only a very brief chat during which she very cordially invited me to a "largish ham tea party" which she traditionally gives at her house the Sunday afternoon following the R.S.G.B. Convention. I was certainly sorry that my sailing schedule prevented my accepting the invitation.

The banquet attendance was very gratifying, being about 260. Since there are only some 2000 British hams, the percentage was excellent. My place was across from EI3G, a tip of whose country I had glimpsed on the trip over, and next to LA3G whose home-town, Bergen, I had passed through just before reaching England. Thus I was able to add two more countries to my list of personal QSO's. Both EI3G and LA3G are now working in London and neither are at present on the air, although LA3G is in hopes of getting a job in Bergen in which case he would again be able to have a station.

The stressing in the speeches of the international fraternal aspect of amateur radio carried especial significance for me, coming as they did just at the conclusion of a trip in which I had found it to be a very real thing. Had the occasion arisen, I could certainly have added my testimony to the genuine friendliness of the radio amateurs of Europe.

Reviewing U. H. F. Propagation

[*Continued from Page 74*]

attenuation considerably, particularly at the higher frequencies. The amount of this increase in attenuation on the higher frequencies probably depends to a great extent on the height of the transmitting antenna in relation to the obstructing objects in its vicinity. More data are required before the relative performance of various frequencies in urban areas can properly be evaluated and compared.

The diffraction factor becomes important beyond the horizon. The diffraction field can be calculated by the methods indicated by Handel and Pfister[6]. In addition to the diffraction field, which is believed to be constant and stable, the refraction field is important beyond the horizon. The refraction field is variable and produces fading. There is insufficient information available to calculate the refraction field.

In general, it is definitely known that the attenuation beyond the horizon increases rapidly as the frequency is increased. The slope of the attenuation curve that fits the available observations best is indicated in figure 1. An approximation of the attenuation for a given circuit may be calculated by using equation (2) up to the horizon and plotting the calculated points on log-log paper. These points will lie

on a straight line having a slope of $1/D^2$. At the horizon, another straight line having a slope determined from figure 1 should be drawn. This line will indicate the order for the attenuation beyond the horizon for a particular frequency. In general, the signal intensity determined in the above manner should represent the maximum, excepting for unusual conditions such as locating the receiver on a mountain top, abnormal refraction fields, sky wave transmission, etc. The available data are based on overland transmission, for which case there seems to be little difference between vertical and horizontal polarization. Over sea water, vertical polarization is superior to horizontal polarization, at least for moderate distances with relatively low antennas[1].

The optical distance for flat ground is easily calculated from the equation:

Distance in miles $= 1.22 \sqrt{\text{Height in feet}}$

If the receiving antenna is also at a high elevation, the same equation may be applied to determine the horizon for the receiving antenna, and this added to the horizon for the transmitting antenna gives the total optical path for that particular set of conditions.

Too little is known about sky wave transmission on the ultra high frequencies. From available information to date, it would seem that sky wave transmission above about 45 megacycles is too spasmodic to give much concern. However, it is possible that more frequent sky wave transmission may be observed at some more favorable phase of the sun spot cycle.

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Designing a 10-Meter Superhet

[*Continued from Page 31*]

for it. Audio amplifies noise and signal alike with any balance there might be in favor of the noise, whereas r.f. and i.f. amplification favor the signal.

Some day, communications-receiver manufacturers will advertise "No audio amplification required for headphone operation on extreme dx signals!", and when that day arrives, the writer will buy some supers, one for each band, but not before. Once again let us say it—a super which cannot work phones satisfactorily out of its second detector is not good enough for "Ten."

Cascade plugging in of coils is not a great improvement over coil switching as evidenced by the more or less similar degree of inefficiency in manufactured receivers of this type when used on 28 Mc.

Ten meters is not quite as tolerant as twenty. You *need* signal and intermediate frequency gain in larger measure than on any other band, and they seem to be more difficult to get. How can one get that extra lift? Certainly not by using a rig that also works on 3.5 Mc. and has one-knob tuning and a good looking wave change switch.

To the uninitiated who have never struggled with the problems of tracking a three gang condenser in a short wave super, it seems possibly a simple thing. But those of us who have, and we too are now a goodly crowd, know full well that just as soon as 28 Mc. signals go a little softer than usual in one small arc of the tuning dial, we fret because we fear the tracking is a little out at this point. The manufacturer does a very good job of tracking above twenty meters, and what he misses he conceals with a 6F5 driving a 6F6 pentode to three watts audio, but check him up on 28 Mc. on the harmonic of JNJ or TDC and note the difference.

Even the 6F6 does not seem able to cloak the sins of the thing and those harmonics might just as well be harmonicas in the same Tokyo.

The old "Super-Wasp" type of construction had two tuning condensers to handle. One was sharp and the other not quite so sharp. Do *you* believe that the kind of operators who get going on "ten" can't spin two dials and keep track of a signal? Of course not, and neither do the manufacturers, but the single-dial tuning habit has so soaked into our blood that, despite its demonstrable inefficiency at higher frequencies, we still, some of us, continue to be dominated by it.

Our opinion is that there is only one good way to tune a super at 28 Mc., and that is to have three separately-shielded compartments, roomy and solid, containing three separate, slow-driven, low-loss midget tuning condensers of such capacity that, tapped across less than half the turns of their tuning coils, they will just spread the band with a few degrees to spare.

When we have done this, we have made a real contribution to both efficiency and peace of mind. It is expensive and it is troublesome, until you become proud of your superiority in dial spinning and acquire an easy rapid method of peaking up a signal once you have found it.

You have at all events given the circuit a fair chance, for, just as truly as you get a bit jaded if left without oxygen, a super becomes feeble if asked to work without inductance, and every half-inch of wire you put back into your tuning coil matters tremendously.

Difficult tuning three dials? Actually, it is not. The oscillator will do for searching alone unless signals are frightfully feeble. Then, after the faint tweet has been located, you trim the mixer grid and the r.f. stage grid to the signal,

and there it is. No rankling doubts in your mind as to whether your capacities are tracking; you've made them track.

Anyway, since we started with the useful premise that we were possessed of unlimited wealth, why not make such a super specially for 28 Mc.? The compartments referred to above would not need to be very large since tubes and components are now all so very tiny, with the phones worked out of the second detector and no audio allowed unless to work a speaker for phone work. Properly engineered, the thing is good with one stage of r.f. amplification, a mixer and a separate oscillator, one i.f. stage using iron-core transformers, and a triode second detector. It is better, though, for two stages of r.f. and two stages of i.f., although in the writer's case, one of the i.f. stages had to be air-core coupled because the gain of three iron-core units tended to make them unstable.

Despite all that has been written against the doctrine of first detector or r.f. amplifier regeneration, the writer believes in it, but, I'm afraid, for the wrong reason. For radiophone reception it is decidedly worthwhile, and it is also useful in the opening chapters of the receiver's life because it sensitizes the whole rig and gives you a better chance of quickly getting all circuits aligned. It is on c.w. that the critics have condemned it, and especially on "ten" should it be condemned. The noise comes up as fast, if not faster, than the signal when regeneration is applied to a c.w. signal. The same amount of increase in signal strength, if obtained by an extra stage of r.f. amplification, will not be attended by the same amount of noise.

So the writer's plan is to use both. That is, two stages of r.f., with regeneration on only one of them. For radiophone, with both stages and the regeneration all going full bore, the result is pretty to listen to. But on c.w. the regeneration control is backed off a bit. There is no question but that the regeneration is worthwhile on phone reception. It seems that it is when the b.f.o. is running that the system becomes noisy.

Selectivity is not, or should one say "not yet," a problem on "ten," so there is little need to include crystal filters: in fact, one should not incorporate anything which operates as a "losser" in a ten-meter receiver. A.v.c.? Gosh no! A.v.c. is not for pioneers: it is for temperamental people who hate having their susceptibilities jarred by Mozart's sonatas being 25 db down where they ought to be andante or fortissimo or something! Without a.v.c., the

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Airline Transmitter

[*Continued from Page 38*]

tube life is obtained by so doing and it is better than running the filaments 24 hours per day. There seems to be no lag in time necessary for the filaments to light. The only tubes that run constantly are the 5Z3's, the 42's, and the speech amplifier. This is a good saving in power, which otherwise would be wasted in lighting the eight RK-20's as used in a four-frequency transmitter.

A photograph also is shown of one of these small four-channel 40-watt phone units, as they are used at the intermediate airports. This should be of interest to the amateur wishing a complete rack-mounted station of low power. Observing the rear view, the cabinet to the right houses the transmitters. The lower unit is the h.v. power supply. The second is the first channel or lowest frequency r.f. unit. The third chassis is the speech amplifier or modulator which has an output of approximately six watts. This is also used for the public address system at the airport for passenger announcements relative to plane departures.

Above this is the battery tray, which holds four dry cells, used for a relay battery, and two small 45-volt batteries which furnish suppressor and control grid bias for the RK-20's. Directly in front of the batteries is the control panel or frequency selector. This merely shifts the high voltage to the desired channel. It is, therefore, possible to shift instantly to one of four predetermined frequencies. The frequency selector switch also switches a common antenna.

The remaining chassis above the control panel are three more r.f. channels. It will, therefore, be seen that four separate r.f. units are used with one common h.v. power supply and modulator. If one r.f. channel should fail, another can be used.

The left hand cabinet, as viewed from the rear, houses the receiver equipment: receivers, mixing panel, stand-by speaker, terminal panel, muting relays, etc.

Several other views of the operating positions of some of our larger ground stations are also shown, as it is believed they will be of interest to the amateur and some ideas may be picked up relative to the commercial arrangement of a modern airport radio station. From the physical arrangement, it will be noted that ease of operation is of primary importance for a fast circuit. A short description of each station is given under each photograph. The transmitters at these stations use W.E. 14-B ten frequency, 400-watt phone and c.w. transmitters and a composite 1000-watt phone and c.w. unit.

Designing a Ten-Meter Superhet

[*Continued from Page 80*]

signals climb a bit sometimes, but, when the signal fades, the non a.v.c. set will have the advantage, and in dx work on c.w., we have no tender susceptibilities; we only know that it is the most important thing in the world that we get as much of that faint signal as we can before it eventually fades out.

Worthwhile additional refinements are controls of the output from both the signal frequency oscillator and the beat frequency oscillator. Taking the former first, it should have an output of more than the requisite number of r.f. volts necessary for normal mixing. Then a control resistor on plate or screen or both will vary it up or down to suit the requirements of the incoming signal.

This should also be done in the case of the b.f.o. Varying its output voltage (at i.f.) helps in weak signal reception quite a lot. The control has to be turned up a bit to receive loud signals sharply heterodyned, but its value lies in its ability to be tuned right down for the reception of those R3 c.w. signals.

One final plea. Let's make the thing a ten-meter receiver only. The conditions for efficiency on 28 Mc. are quite different from all the other bands. One receiver can quite well work from 20 meters upwards; another can work from 5 meters downwards, but a ten-meter receiver is a problem of its very own.

The perfect rig seems to demand air-wound, self-supporting, copper wire coils that can be tapped easily and neatly in any turn; coils that can be soldered directly onto their tuning condensers. It should begin to look like a daintily engineered 10-watt transmitter.

And it's still true that the best possible ten-meter super has yet to be designed.* Ten years from now the above statement will still be in order. "This 'ere progress," said Samuel Weller, "keeps goin' on!"

*A step in that direction is the 10 meter Super described by Ray Adams in the October, 1937, RADIO.

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Clear Frequency for I.F.

The RMA is attempting to establish 455 kc. as the standard intermediate frequency. Since interference on the i.f. channel is an important item, the R.M.A. has attempted to have the F.C.C. set aside the band of frequencies from 450 to 460 kc. as a protected i.f. band.

A letter, setting forth the following policies, was sent to and accepted by the F.C.C.:

"1. That the Commission will endeavor not to authorize any new frequency assignments in the band 450-460 kc.

"2. That no change in existing assignments within this band will be made by the Commission.

"3. That in case a change of policy in regard

to numbers 1 and 2 above is necessitated at a later date, the Commission will notify the Radio Manufacturers' Assiciation of any contemplated action."

More About the Signal Squisher

Several amateurs have written in to tell us that while their "Signal Squishers" have increased their average dx reports from 1 to 3 "R" points, they get fairly good reports from stations "off the sides." The reason for this is that when used in a horizontal position (as it should be for 10 and 20 meters) the antenna has two minor lobes at right angles to the two main lobes. About 90 per cent of the power is concentrated in the main lobes, but there still is enough power radiated by the minor lobes to put out a signal that is only a couple of R points down from the main lobes.

When the Squisher is used vertically, as it should be on 5 meters, the orientation is such that the minor lobes go straight up and straight down. Hence when used this way (vertically) on 5 meters the squisher is highly directional, the radiation broadside to the affair being practically nil.

F.C.C. Asks Co-operation

The Federal Communications Commission has asked the cooperation of the radio manufacturing industry in regard to the sale of transmitter kits or built-up transceivers. The manufacturers of the kits are requested to include in each unit a form letter prepared by the F.C.C. advising the purchaser that a federal license is required for the operation of the equipment. The manufacturers also were asked to include a statement to this effect in their catalogs or descriptive literature concerning such equipment.

All-Year Portable

[Continued from Page 50]

Another point that will help when working at the crystal frequency is: The doubler section may be left running by leaving the following doubler coil coupled to it to stabilize the load. This will also keep the voltage more constant due to the regulation of the power supply.

Tune the exciter section with a tuning lamp and watch the plate current to see that it does not run over 60 ma. Tuning with the meter will be found difficult; the pickup lamp is better. When the exciter has been tuned to resonance throughout, go back over it and retune with the meter in the grid current lead of the 802, remembering to keep the grid current below 5 ma. This finer adjustment will be helpful, especially when tuning to 10 meters.

Final amplifier plate tuning is done with the plate milliammeter. Set the antenna coupling condenser at maximum, apply the plate voltage and insert the meter plug, and tune the plate tank condenser to resonance. In case it is desirable to use two-wire feed of any type, the antenna condenser is set at maximum; a link is placed around the tank coil of the final and run to an external antenna coupler of any type desired, and the final is loaded in the same manner as any series- or parallel-fed circuit.

When loading to a single-wire antenna, attach the antenna lead to the binding post and again tune the plate tank condenser to resonance. If the plate current is lower than the desired amount, tune the antenna condenser slowly toward the minimum position, and at the same time keep tuning the plate tank to resonance until the plate current is the proper amount.

If the plate tank condenser will not tune to resonance before the plate current rises to the amount wanted, the number of turns in the tank coil will have to be increased. Adjust the number of turns of the plate tank coil to reach resonance with the antenna condenser at maximum capacity and the plate tank condenser as near minimum capacity as possible. No trouble should be had unless it is when employing a long antenna for use on 160 meters. However, I found it more satisfactory to use the large Bud form for 80, 40, 20 and 10 meters and a separate coil for 160 meters. Also, when best plate efficiency is required on the higher frequencies, it is better to use individual plate coils rather than the large tapped coil.

It is best to make the preliminary tune-up with the suppressor-grid voltage set for c.w. operation, or about 45 volts positive. Having the positive voltage on the suppressor increases the output of the 802 quite an appreciable amount. Then for phone operation, the suppressor voltage should be negative and adjusted so that the plate mils of the 802 read one-half the amount they do for c.w. operation. Consequently, the output drops off, but that condition is necessary to obtain 100 per cent modulation. Adjust the gain control so that the plate meter just barely moves when speaking into the microphone. The plate meter should increase slightly under modulation. If it drops off, the suppressor voltage is not correct and the final should be retuned for c.w. operation with the suppressor voltage positive. Then return the switch to negative and adjust the bias to the point where the plate current drops to half the c.w. value.

Local Color

F.C.C. means *first class certificate*, according to Webster.

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There was another fellow whose 160-meter phone made QRM for the local police broadcast station, due to over-modulation. He immediately set out for the nearest radio supply store, telling the fellows he was going to buy a class-B transformer with a sharp cut-off to prevent over-modulation.

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A lad inquired as to whether he could put the secondary of his class-B transformer in the negative supply lead as well as the positive. Informed that he could, he placed it in the circuit between negative B and the filament center tap and made the grid return to ground. If this had been a pentode instead of a triode, he would have had grid, suppressor, screen and plate modulation! Of course, even with a triode the contraption was hardly intelligible and covered almost the entire 160-meter phone band. When the local gang got wind of what he had done, someone suggested that he also arrange it to modulate the filament supply, whereupon he informed his advisor that he doubted if the class-B transformer secondary was capable of carrying the filament current.

Impedance Measurements

[*Continued from Page 53*]

used permanently as the impedance-matching unit, there is nothing to be gained in eliminating the reactance of the antenna; as long as it is cut to approximately the right length, its radiating characteristics will not be greatly altered by a few inches difference of length. And the stub will take care of matching the transmission line. The same may be done with the "Q-bars" if their length is other than a quarter wave.

The author greatly appreciates the criticisms, suggestions, and experimental results furnished by John D. Kraus, W8JK, of Physicists' Research, Inc.

Antenna Design—790 Kc.

After three months of preliminary testing of soil, WGY is prepared to begin the erection of its new 625 foot vertical. Many weeks were devoted to the selection of the site for the new antenna. Proximity to airways, electrical soil conductivity, and the site's relation to the key cities of the coverage area, were all considered.

After the selection of the site, extensive tests were made on the soil itself to determine if it were capable of supporting the half-million pound structure. The actual tower will exert a thrust of about 3000 pounds per square foot on the base.

The ground system for the new antenna will consist of more than 13 miles of copper ribbon, buried six inches below the ground and extending $\frac{1}{2}$ wavelength out in all directions from the base of the tower.

What a lucky thing it is that we hams are assigned the higher frequencies of the radio spectrum. While a half-wavelength on 790 kc. is about 600 feet, a half-wave on ten is only 16 feet; what a difference this makes when you start to design an antenna system. Even on 160 meters, our lowest frequency band, one-half wavelength is only about 260 feet.

More "Calls Heard"

Frank Frisch, W2JVU, 1409 Brook Avenue, New York City. (July 7 to 25)

(14 Mc.)

CX1BZ; CX2BK. — D—3ANK; 3DSR; 3FZI; 4CBG; 4CDQ; 4DLC; 4DRF; 4HCF; 4HNG; 4JFG; 4NYR; 4SCK; 4SZK; 4XJB. EI7F; ES5D. — F—2AQ; 3CX; 3MN; 8EB; 8IZ; 8PQ; 8RC; 8UK; 8VT; 8WK. FA8BG; FB8AD; FM8AD; FP8PX; FT1AF. — G—2DL; 2HW; 2JG; 2KM; 2LA; 2LB; 2MI; 2QB; 2TH; 2TR; 2XW; 2YK; 5AD; 5AO; 5CG; 5HH; 5OJ; 5OW; 5QA; 5QI; 5YU; 5YV; 5ZB; 5ZE; 5ZS; 6GB; 6LC; 6LJ; 6LR; 6QN; 6WB; 6ZS; 8GB; 8HH; 8II; 8PC. GM6XI; GM8CT; HA6A; HB9BL; J2CL; KA1ER; LA1N; LU3EV; LU4BQ; LU4CH; LU4RB; LU6AX; OA4AQ; OE3AH; OE7EJ; OK1CX; OK2BK; ON4BR; ON4DX; ON4FX; ON4IF; ON4JZ; ON4SS; ON4VU; OZ2B; OZ7CN; OZ7UU; OZ8M. — PA—0CE; 0CX; 0CO; 0EX; 0FO; 0GN; 0JJ; 0KN; 0KSK; 0MS; 0NW; 0PN; 0SD; 0UB. PK1RI. — PY—1CI; 1DH; 2BU; 2EC; 2FR; 2HG; 2HJ; 2HM; 2HN; 2JO; 2KX; 2LA; SM7PA; SM7UC; SU1CH; SU1DB; SU2TW. — VK—2BR; 2JO; 2VA; 3GA; 4DU; 5HG; 5IV; 5JB; 5JS; 5LL; 5RT; 5XB; 7CM. VS7RF; ZB1W; ZL2FX; XS1AH.

•

Bob Everard, "Oakdene," Lower Sheering Rd., Sawbridgeworth, Herts, Eng. (August 18 to September 18)

(14 Mc. phone)

W—5AKK; 5AMK; 5ANZ; 5AWE; 5BCU; 5BEK; 5BIN; 5BJO; 5CYC; 5DAN; 5DEW; 5DQ; 5DUK; 5DVM; 5EHN; 5ERL; 5EYV; 5GAR; 5GIB; 5PDI; 5YJ; 5ZA; 5ZS; 6AL; 6AMB; 6AQK; 6ATQ; 6BAW; 6BJB; 6CFJ; 6CME; 6CNA; 6CUU; 6DDA; 6FDN; 6FKK; 6WU; 6GCT; 6GCX; 6HOW; 6IDV; 6ISH; 6ITH; 6IXJ; 6JKR; 6JPQ; 6JT; 6KQQ; 6LFU; 6LLQ; 6LVS; 6LYP; 6MLG; 6MVD; 6MWK; 6NBG; 6NFP; 6NLP; 6NMI; 6NNR; 6NTX; 6QAJ; 6OCH; 6OCH; 6QD; 6YU; 7AIC; 7ALZ; 7AMQ; 7APD; 7BL; 7BUH; 7BVE; 7CEV; 7DNP; 7DVY; 7EGV; 7EKA; 7ESK; 7FQU; 7VA (portable); 9GTQ; 9JB; 9UJS. HC1FG; HC1JB. — K—4DDH; 4SU; 6BAZ; 6BNR; 6CMC; 6KFV; 6KMB; 6MXM; 6NTV; 6NZQ. 6OQE; 7BFE. KA1HS; KA1JR; KA1ME; KA1YL. — LU—1HI; 1JC; 4BH; 4BL; 5CZ; 6KE; 7AG; 8AB; 9BV. PK1MF; PK1MX; PK1QU; PK1ZZ; TI2AF; TI2AV; TI2BG; TI2KP; TI2MC; TI3AV. — VE—3GS; 4AC; 4AK; 4AU; 4BD; 4CW; 4EA; 4FI; 4HU; 4IF; 4JJ; 4KX; 4LZ; 4MO; 4OF; 4TJ; 4UM; 4WJ; 5AM; 5BF; 5EF; 5HI; 5JK; 5OA; 5OT; 5PE; 5UW; 5VO.— VK—2ABG; 2ADE; 2AP; 2AZ; 2BW; 2CE; 2HF; 2IQ; 2NY; 2QR; 2RJ; 2TI; 2VB; 2VV; 2XS; 2XU; 3GK; 3GQ; 3KR; 3LL; 3PE; 3TL; 3UL; 3WA; 3XJ; 3ZL. VS1AI; VS2AK. — VU—3AL; 3KX; 3MR; 3ZJ; 4JU; 4KV; 4WU; 5AI; 5AW; 5GF; 7CL. ZS6AJ; ZS6Q.

(28 Mc. phone)

W—5ALK; 5CCU; 5DUK; 5DUQ; 5DSU; 5EZB; 5FBR; 5FNH; 5FZY; 5GHW; 5GGX; 5YJ; 5ZA; 6AM; 6CHR; 6EBH; 6ERT; 6FZL; 6GCX; 6HUM; 6ITH; 6JJU; 6MBD; 6MWK; 6NDC; 6NLP; 6NLS; 6NTR; 6NXF; 6OIS; 6OSH; 6OGC; 7EMP; 7ESK; 8AHE; 8AVB; 8BIQ; 8BTO; 8CLS; 8EBS; 8EUU; 8GXU; 8IFC; 8KYY; 8LGO; 8LIF; 8OMY; 8PWA; 8QKI; 8QUL; 9ABX; 9AGO; 9ARK; 9BBN; 9CNE; 9CQR; 9CVN; 9DDF; 9DRQ; 9DXP; 9ELL; 9GHY; 9JBO; 9KZN; 9LLC; 9PWU; 9PQH; 9RH; 9SJV; 9TPU; 9TTB; 9UEL; 9UPX; 9WED; 9WIQ; 9WLD; 9WTN; 9YJH; 9YOC; 9YRX; 9ZJN. K4EIL; K4EPO; K4SA; LU7AG; SU1RO; VE2KX; VE3TY; VE4BD; VU2CQ; ZS6AJ; ZU6J.

5-10-20

[*Continued from Page 24*]

ham transmitters for the higher frequencies. It fulfills the requirements outlined in the opening paragraphs and can be constructed economically and with a minimum of handwork. Parts are standard and readily obtainable, and output is adequate—with no "cheating" (cutting power input) necessary on the higher frequencies. For those who would like to build one, the diagrams and photos will give most of the constructional information necessary. Either the author or the designer will be glad to assist with any additional help that might be required.

56 Mc.

[*Continued from Page 70*]

has been attributed to low atmosphere bending, inasmuch as there does not seem to have been a complete skip over most of the path, even though the distance to some of these stations appears to be more than 300 miles. W3DBC is another who heard W5EHM on June 27. He uses a modified Lafayette resistance-coupled

[*Continued on Page 95*]

Adjusting the Horizontal Rhombic

[*Continued from Page 62*]

sufficient inductance may be introduced into the circuit from this source to secure the desired inductive reactance at the antenna. However, such a coupling device, by virtue of this very property, would defeat its purpose, i.e., if inductive reactance were introduced by this means, then the device would have a large amount of leakage flux and would not be so desirable as one which provided tighter coupling between the two circuits with less flux leakage. Hence, if sufficient inductive reactance is not introduced from this source, it may be readily had by inserting a couple of small series coils into the circuit at the end of the antenna.

The termination of the antenna is effected by varying the position of the taps on the auto-transformer until the desired value of terminating impedance is obtained.

The impedance of the terminating device may be adjusted before the device is connected to the antenna by measuring it while stretched out near the ground. The proper position of the taps can be selected while the device is still on the ground by measuring the impedance and adjusting the taps until the desired value

is obtained. It may then be connected to the antenna and the performance of the antenna with the device connected checked once again; if minor adjustments are in order, they may then be readily made. The advantage of this method of terminating the antenna is that it will work well over a wide range of frequency; its cost is small, and it doesn't require a city block in which to stretch it out. All three of the terminating devices described are capable of easily dissipating a kilowatt of energy without change of characteristics.

Special Receiving Considerations

When the antenna is used for receiving, it is important that the impedance of the sending end of the antenna be matched by the impedance of the feed line connecting it to the receiver. If this is not done, reflection of the incoming signal occurs at the near end of the antenna and the radiation pattern of the antenna for receiving is altered from its pattern for transmission. This same mismatch will result in a loss of signal by this very same reflection. Hence, to secure the maximum signal strength, the impedance must be matched at this point. To match the antenna to the line at the sending end, the previously described autotransformer will do the job very nicely. Losses are low and one may have no fear of using even a "California kw." with it.

The final point to be mentioned is matching the feed line at the receiver. A mismatch at this point will also cause trouble at the antenna, since the impedance of any feed line at one end is determined by the length and size of the line and by the value of impedance used to terminate it at the other end. The simplest method of terminating the receiving end of the line properly is to measure the input impedance of the receiver and to adjust it to the desired value by varying the position of the coupling coil in the receiver itself until the desired impedance is obtained.

Lots of Work But Worth It

Though the work necessary to adjust the diamond antenna properly may seem to the average amateur a laborious and lengthy process, and though many may no doubt think it not worth the trouble to make the necessary adjustments to assure proper performance, we are of the opinion, in the light of our experience, that such adjustments will more than repay the person making them. The improvement which they will make in the performance of the antenna, even though the performance with hit-or-miss values may be good, is nothing short of astounding.

APPENDIX

The following generalized equation may be shown to hold for any transmission line excited with sinusoidal e.m.f.

$$Z_s = Z_o \frac{Z_r \cosh \delta l + Z_o \sinh \delta l}{Z_o \cosh \delta l + Z_r \sinh \delta l} \quad (1)$$

when:

Z_s = sending-end impedance
Z_r = receiving-end impedance
Z_o = line impedance
l = line length
$\delta = (\alpha + j\beta)$ = propagation constant.

[*Continued on Page 91*]

DX

[*Continued from Page 68*]

A novel get-to-gether was held in Hermosa Beach, California, during the latter part of September. It was a DX Roundup and there were 120 of the best dx men in Southern California present. It is the first time anything like that has been run off and you can bet . . . everyone was trying to outdo the next guy. If I were to print the list of the ham's calls who were there, you would realize what a lot of kws. were represented. In fact, the joke of it was that it was on a Saturday night and here were all of the best dx men in this vicinity . . . OFF the air. What a paradise it would have been for one or two fellows to get on the air.

That brings me up to this point . . . the next day I bumped into one dx man who hadn't heard of the meeting and was home as usual. He said, "Gee, you know last night was sure funny . . . why, everything I would call would come back to me, and not only that but those Europeans were calling me after each QSO." After he had spent a very successful p.m. on the air, he said he noticed there wasn't much W6 QRM and wondered why. He then thanked us profusely for having the meeting. All the c.w. and phone dx men were there . . . and the next one we have will be in the middle of the next dx contest, I think . . . not.

Looking around at conditions locally I find a lot of funny things. These previously mentioned dentists, W6MLG and W6FTU have a system . . . MLG goes out and finds this elusive dx and works it . . . then calls FTU on the phone and gives him the dope . . . next thing, FTU works him. You see, this enables FTU to sit around and play poker or something . . . until MLG calls him, then he goes into action. FI8AC is their latest triumph. Anyway, they have lots of fun . . . and yes, they are on phone. They were at the dx meeting, but got there a little late . . . said they got lost in the fog.

And now CUH is on the air again . . . as a matter of fact he worked a VK last night. His new final amplifier is tremendous . . . yes sir, it will keep him warm during this cold winter. Charlie isn't saying whether he is going on fone or not . . . but I have a little hunch of my own about it. You'll probably see a picture of it sooner or later . . . but on 28 Mc. he will still be using the 250TH's. Speaking of final amplifiers, take a look at a neat one kw. job for 10 and 20 meters, in the front part of this issue of RADIO. Uses a couple of 100TH's for a kw., or 35T's for 500 watts.

Well, gang, things around Manhattan Beach have not been so hot lately, conditions have been o.k. but with conventions and what not, I haven't done justice to the W9's . . . but from now on, we're going to town. No changes were made in the zone or country listings this month, but will be made next month. Get your latest and send them in. In case some of you do not know the zones, you can still get the zone maps for twenty-five cents. Just shoot in your quarter to the office and it will be mailed to you. In your spare time why not get your rig set for 40 meters and when December rolls around I'm sure we'll all have some fun. The boys are really going in for the VK-ZL contest this year and I think that is a swell idea. Those fellows down there are a great gang and good ops . . . and from the sound of their signals bet they have really souped it up for the test. Hi. The W boys haven't forgotten how to go after them either . . . a few of them around here that are serious about it are W6FZL, CXW, NKY, HX, ADP. From the sound of W8ZY and W8BTI, W4CBY, W1JPE, W1TW, W9ARL and a flock of others that I don't recall at this last minute, they are not churning out kilowatts for nothing.

Old time VK's in there are 3EG, 2AD, 2HF, 3WL, 5FM, plus many others, also got a kick out of getting ZL2CI, 1GX, 1DV all old timers. The contests surely drag 'em out of their shells. Even QD fell out of a warm bed at 4 a.m. . . . must be going nuts. Anyway, darn it, everyone was having fun.

Oh Look!!!

F8EX is back on the air after a layoff of about two years. You see he was married two years ago. Anyway Jean said during a QSO . . . "Am back on air with new rig, new QRA . . . and new baby." Didn't find out whether it was a yl or an om, but in either case Jean will have a Jr. op. Congrats . . . . F8EX.

That's enough for this time, 'fellers', and you phone men between now and next month better get a book and study up your Spanish, and you c.w. men should do the same . . . just in case you do go on fone . . . sometime. Take it easy, and better check the shunts on those meters. Now for a good ol' W9.

Question Box

[*Continued from Page 72*]

by a conductor will induce an e.m.f. in that conductor". This statement, while it does describe a majority of cases, does so only by coincidence, and is not literally true for all cases. A conductor moving in a magnetic field so as to cut many lines of force still will *not* have an e.m.f. induced if the field strength is everywhere constant and the angle between the conductor and the field does not change.

The accepted view of induction phenomena is that there must be a variation of the total flux passing through a given circuit in order for an e.m.f. to be induced in that circuit. Thus, the e.m.f. induced in any particular circuit is expressed mathematically as being equal to $E = \dfrac{\textit{change in flux}}{\textit{interval of time}} = \dfrac{\Delta\ \phi}{\Delta\ t}$

This is expressed in words by saying that the electromotive force induced in any circuit is equal to the "time rate of change of flux".

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I am using a crystal microphone on the input of my speech amplifier. Up until now, the transmitter has been located in the same room as the microphone and as the speech amplifier is built into the rig, I have used the cable that came with the mike to go from it to the rig. I intend to move the rig into another room and remote control it from the operating position. Will it be necessary to remove the speech amplifier from the rig and keep it in the operating room or will it be possible to run the mike cable into the other room without a loss of high frequencies?

It is perfectly permissible to run a concentric cable, of reasonable length, from a crystal microphone, or a condenser microphone for that matter, to the amplifier that it feeds. This is due to the fact that these types of microphones are capacity-operated devices; the capacity of the extension cable will attentuate the output of the microphone but will not discriminate against any particular frequencies. This is based, of course, on the assumption that the cable is amply shielded and that its internal resistance, both series and shunt, is not of the order of magnitude of the capacitive reactance of the cable and mike. This condition is satisfied if the cable is not too long (lengths up to 100 feet are permissible for a crystal and up to 10 or 20 feet for a condenser) and if it is of the large-diameter low-capacity type similar to that used in automobile antenna lead-ins.

Adjusting the Horizontal Rhombic

[*Continued from Page 89*]

It may also be shown that:

$$\alpha = \frac{R\lambda}{2Z_0} \text{ at high radio frequencies}$$

$$\beta = \frac{2\,\pi}{\lambda} = \frac{2\pi\,f}{c}$$

when:

λ = wavelength
f = frequency
c = velocity of propagation

Now:

$\cosh(\alpha + j\beta) = \cosh\alpha\cos\beta + j\sinh\alpha\sin\beta$
$\sinh(\alpha + j\beta) = \sinh\alpha\cos\beta + j\cosh\alpha\sin\beta$

If α is not equal to zero:

$\cosh(\alpha + j\beta) = \cos\beta + j0$
$\sinh(\alpha + j\beta) = 0 + j\sin\beta$, and:

$$Z_s = Z_0\,\frac{Z_r\cos\beta\,l + jZ_0\sin\beta\,l}{Z_0\cos\beta\,l + jZ_r\sin\beta\,l} \quad (2)$$

[*Continued on Page 93*]

The Open Forum

[*Continued from Page 73*]

The most puzzling part of Wellar's letter, it seems to me, is the statement that he has spent all of his spare time in acquiring a sound knowledge of technical radio. How he has the perseverance to acquire this knowledge and yet lets a little thing like 13 w.p.m. buffalo him, has me beat! It seems that anyone who would try to learn code while he is in the same frame of mind as he is when he tries to understand some of the modern radio theory, would have little difficulty in making the code requirement.

In closing, I would suggest two things to fellows like Wellar who experience trouble in meeting the 13 w.p.m. ruling: (1) Tackle the subject with the belief that you *can* learn it. (2) Study the subject with the idea that you are learning it not just to please the R. I., but for your own use after you get your ticket.

WAYNE J. SULSER, W9NVF

Re The Wellar Letter

Cincinnati, Ohio.

Sirs:

Reading Mr. R. Wellar's letter in the "Open Forum" of the July issue prompts this letter along the same lines.

It does appear to be a rather ancient method of determining the ability of a would-be "amateur" by the applicant's knowledge, *primarily*, of code at a 13 w.p.m. rate, and an examination which, from our observation, is rather easy to skip through.

A rather stringent exam to determine the actual technical knowledge of radio possessed by the applicant would prove his ability to get a rig on the air with a minimum of interference and keep it operating as a real transmitter should function.

The ability to pass the code exam is no indication of ability to operate a station, and there are many owners of "tickets" who learn the fundamentals after getting their license, and by considerable experimenting while their transmitters are on the air, inflicting grief in the form of interference on the band, as well as b.c.l. and other types of causes for complaint.

Any doubt of this would disappear after listening into the 160 band, for instance, or even 80, where many examples of improper knowledge of the equipment they are using can be heard, and ability to handle code at 13 or 30 w.p.m. won't help this condition.

By all means, let's have a real honest-to-goodness exam for a class B phone license, and relegate the code requirements to the past, or keep it, as it is a necessity there, for the class A, or for commercial operators' examinations.

In this writer's belief, this would be a big step toward improved operation, and would result in a better condition on the phone bands.

B. P. SCHROEDER.

PHOTOS WANTED FOR RADIO

Nothing enhances a magazine as much as good photographs of interesting and varied subject matter. Unfortunately, photographically interesting radio items are rare, though they do exist. We keep a weather eye peeled for them around here, but must depend upon you for likely items from your neck of the woods.

Acceptable snapshots average a $2.50 payment; some run to $5.00; $1.00 is minimum. Pictures which tell a story are especially good. Radio scenery and apparatus are in order. Many "personality shots" can be used as well.

Adjusting the Horizontal Rhombic

[*Continued from Page 91*]

This reduces to: (3)

$$Z_s = Z_o \frac{Z_r Z_o + j\,(Z_o^2 - Z_r^2)\sin\beta l \cos\beta l}{Z_o^2\cos^2\beta l + Z_r^2\sin^2\beta l}$$

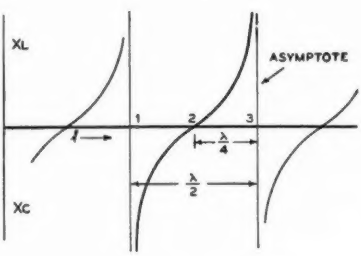
Now let $Z_r < Z_o$. Then $Z_s = c + jd$ (where c and d are generalized values). However if $Z_r > Z_o$, $Z_s = c - jd$. In the first case Z_s is inductive, in the second it is capacitive.

If $Z_r = Z_o$ then $Z_s = Z_o$, which is the case of a line of any length terminated in its characteristic impedance.

Now $\beta = 2\pi/\lambda$, so $\beta l = 2\pi l/\lambda$. If $l = n\lambda/4$, $\beta l = n\pi/2$ when n is any integer.

Hence the equation (3) will have the form $a + j0$ when the imaginary term is zero. This will occur when either $\sin\beta l$ or $\cos\beta l$ is zero or when $Z_r = Z_o$. Since $\sin m^{\pi}$ and $\cos u\pi/2 = 0$ when m is any integer and u is any odd integer, $Z_s = a + j0$ for multiples of $l = \lambda/4$. Hence the points of zero reactance are $\lambda/4$ apart.

When $Z_r = 0$, from (2) we derive, $Z_s = jZ_o \tan\beta l$. This may be plotted thus:



Again, from equation (2), when $Z_r = \infty$, $Z_s = -jZ_o\cot\beta l = -jZ_o\tan(\pi/2 - \beta l)$. Thus, for $Z_r = \infty$, the same relation holds as for $Z_r = 0$ except that the nodal points, etc., have been shifted by a distance corresponding to $\pi/2$ electrical degrees or one quarter wavelength.

When $Z_r = Z_o$ the line is non-resonant. For values of $Z_r < Z_o$ or $Z_r > Z_o$ the line exhibits increasingly resonant properties as Z_r approaches zero or infinity. Points 1 and 3 correspond to voltage loops (current nodes), and point 2 corresponds to a current loop (voltage node).

If l' is a length of line corresponding to a point such as at 1 or 3, and if l is the actual length of line, when $l < l'$ but $> l' - \lambda/4$ the line is inductive in reactance. When $l > l'$ but $< l + \lambda/4$ the line is capacitive in reactance. At points 1, 2, and 3 the reactance is zero.

Introduction of Reactance by Resistance in Transmission Line

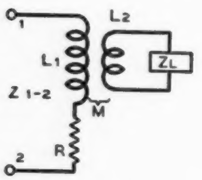
In the derivation of (1) it may be shown that:

$$Z_o = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

Where R is the resistance, L the inductance, C the capacitance, and G the conductance, each per unit length of line. G may be assumed to be equal to zero without error. Hence:

$$Z_o = \sqrt{\frac{R + j\omega l}{j\omega C}} = \sqrt{\frac{\omega L - jR}{\omega C}} = p - jq$$

where p and q are generalized quantities. Hence, when the resistance of a line becomes appreciable, its surge impedance is no longer a pure resistance but becomes a complex impedance having a capacitive reactance.



The Coupling Transformer

For the following circuit it may be shown that:

$$Z_{1-2} = R + j\omega L_1 + \frac{\omega^2 M^2}{Z_L + j\omega L_2} \qquad (4)$$

Let $Z_L = r_L + jx_L$; then $Z_L + j\omega L_2 = r_L + j(x_L + \omega L_2) = r_L + jx_S$, where x_S is the total reactance of the secondary.

Equation (4) now reduces to:

$$Z_{1-2} = R + j\omega L_1 + \frac{\omega^2 M^2}{r_L + jx_S} \cdot \frac{(r_L - jx_S)}{(r_L - jx_S)}$$

$$Z_{1-2} = R + j\omega L_1 + \frac{\omega^2 M^2 (r_L - jx_S)}{r_L^2 + x_S^2} \qquad (a)$$

$$Z_{1-2} = R + \frac{\omega^2 M^2 r_L}{r_L^2 + x_S^2} + j\left[\omega L_1 - \frac{\omega^2 M^2 x_S}{r_L^2 + x_S^2}\right] \qquad (5)$$

The term $\frac{\omega^2 M^2 (r_L - jx_S)}{r_L^2 + x_S^2}$ in expression (a), reduced to $\frac{\omega^2 M^2}{r_L^2 + x_S^2} - j\frac{\omega^2 M^2 x_S}{r_L^2 + x_S^2}$ in eq. (5), may be said to be the "coupled impedance" due to the presence of L_2 and Z_L.

Hence whenever $Z_L + j\omega L_2$ is reduced to $r_L \pm jx_S$, the coupled impedance is seen to become:

$$Z\ \text{coup.} = S \pm jY, \text{ where } S = \frac{\omega^2 M^2 r_L}{r_L^2 + x_S^2},$$

$$\text{and } Y = \frac{\omega^2 M^2 x_S}{r_L^2 + x_S^2}.$$

The action of an auto-transformer is similar, but considerably more difficult to analyze.

56 Mc.
[Continued from Page 88]

superheterodyne. The antennas are a matched-impedance vertical job and a 45-degree tilted five-half-wavelength wire.

W9CLH also was reported on August 18 at around 4 p.m. Eastern time by W2JUW and W2IQD. We received a report from an Ohio station covering east coast reception at the same time, but have misplaced the card.

R7 Report Given

Again, on August 23, W9CLH was reported at 7:25 Eastern time, this time by W8CXX in Ambridge, Pa. The report was R7, fading abruptly. While this is a single report, it has been confirmed at both ends.

An unconfirmed report was received from W1KBM covering Sunday, September 19. On this day, W1SS in Arlington Heights, Mass., reports hearing a station signing W9MB (in St. Louis) at 12:27, 7:20, and 8:40 p.m. Eastern daylight time. W9MB was sending test and his call letters, using i.c.w. We have written for a verification, but it hasn't come as yet.

In late August and in September, occasional days are expected on which summer conditions might appear, while on other days, winter conditions might be expected. Sporadic E layer conditions are possible though might not occur as often as in the May-August period. This would permit 500- to 1000-mile work. Mostly, however, we expect somewhat longer distances to be reported during the September-April part of the year, on days when the F_2 layer critical frequency is especially high.

Judging from the letters we receive and comments over the air overheard, there is getting to be considerable interest in five meter dx, which was reviewed in the July and October issues of RADIO. It will take reports, though, for us to bring you this news, because we can't just listen in as we did on 28 Mc. to find out who is doing the dx work.

Another 56 Mc. Expedition

Dick Sampson, W6OFU, along with W6OZM, W6OSD, W6LJP, and W6LYG plan to go to Mt. Mingus, 11,000 feet, and try for some 56 Mc. dx on the first Sunday in November. They will start calling at 7:30 a.m. Mountain time and continue to 5:00 p.m. at intervals of 15 minutes. They will use a rotatable antenna pointed in the direction of various stations in California, Nevada, Utah, Colorado, New Mexico and Arizona with whom they will make schedules. The frequency will be a multiple of 7,100 kc., sometimes on 28,400 but mostly on 56,800 kc.

Any stations in the Southwest wishing to participate should write to R. T. Sampson, Chief Engineer of KCRJ, Jerome, Arizona giving the time of proposed schedule and approximate direction from Mt. Mingus (in the exact center of Arizona, 7 miles from Jerome).

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Do You Collect Stamps?

If you are a philatelist as well as a "ham", please let RADIO know about it. For several months—after requests from many of its readers—the magazine has been printing the names and calls of those who go in for the two hobbies. Here are some additions to the list.

Bill Wilkinson, Unity, Sask., Canada, is another VE who collects stamps and experiments with amateur radio. His call is VE4QL.

Another stamp collector and ham is Allen G. Brown, VK3CX, Flat 2, 252 Riversdale Rd., Hawthorn, E. 3, Victoria, Australia.

Whereinell's That QSL?

Some moons ago, ol' pal, ol' pal, we had a QSO—
Mayhap 'twas short, mayhap 'twas long, as ether contacts go.
But whether it was long or short, I have this much to add—
It gave me just as big a kick as any I have had.
Next day my card, addressed to you, before the thrill should fade,
I place in care of Uncle Sam, with postage fully paid.
Day after day I've watched the box upon my castle's door
Wherein each month the postman drops statements and bills galore.
Days ran to weeks, weeks into months, and still from you there came
No sign, no word, no scratch of pen to bolster up my fame.
My friends demand of me full proof of every statement made:
Full long I've trailed the wary trout—the game of golf I've played.
How can I, then, convince them well that I have talked with you
Unless you send something to me that proves my story's true?
Your card would be the very thing, and none could doubt me then—
Its place upon my shack's bare walls awaits your trusty pen.
Again I ask you, pal o' mine, deny no more my plea—
Just get the lead out of your feet and send that card to me.

—W6NGV's QSL card.